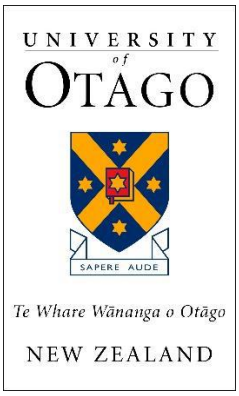
The barriers to, and opportunities for, restoring wetland ecological function on privately-owned New Zealand farms



Chantal Whitby

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Abstract

In New Zealand, the ecological functionality of freshwater systems have been significantly affected by agricultural intensification. This decline in freshwater health is such that it is now considered one of the country's most pressing environmental issues. As freshwater quality is a complex problem there is no one solution. However, establishing wetlands is a recognised method for improving freshwater health. Unfortunately, a large number of wetlands in New Zealand have been modified through drainage and agricultural development, and many others have been degraded. Thus, it is important to identify ways in which to work effectively with farmers to address these issues. While some research exists on the restoration of functioning ecosystems on farms, there are few studies on the restoration of wetland ecological function on New Zealand farms. Therefore, the purpose of this research is to investigate the barriers to, and the opportunities for, restoring wetland ecological function on privately-owned New Zealand farms.

Data was collected at a national level through an online survey, and at a finer scale through eight case study farms which had established, or intended to establish, wetlands. The study revealed that economic factors had less influence on farmers' decisions to restore ecological function than suggested by previous research, with land characteristics and personal characteristics being the most significant influences. Additionally, it was found that farmers were not necessarily motivated to establish wetlands for environmental benefits; their motivations changed as wetland projects progressed; and their lack of disposal time had a significant negative effect on wetland creation. Importantly, this research also showed that farmers who were able to align wetland projects with their personal and business goals were more likely to establish wetlands.

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List of Abbreviations

EF	Ecological function
F1 – F8	Farmer 1 to 8
ha	hectares
KI1 – 3	Key informant 1 to 3
OECD	Organisation for Economic Cooperation and Development
RMA	Resource Management Act 1991

1. Introduction

1.1 Research issue

Worldwide, farmers control a major proportion of the Earth's natural capital, which is indispensable for both the production of commercial assets and social wellbeing. The growing human population increasingly places higher demands on agricultural production rates, therefore putting more pressure on the already extensive agricultural sector (Badgley, 2003; Stuart and Gillion, 2013). This has resulted in the rapid intensification of agriculture in many countries, demanding more from the land and thus leading to major alterations in the ecological functioning abilities of the landscape. For instance, over the last two decades New Zealand has experienced a dramatic increase in agricultural intensification, with pastoral landscapes now accounting for 40 percent of the country's total land area (Ministry for the Environment and Stats NZ, 2017). These increases in land use pressure often result in the degradation of ecosystem health and a decrease in the ability of those ecosystems to provide resources on which living organisms, including people, rely (Stuart and Gillion, 2013). Freshwater is one such resource which has been significantly affected, with its declining health repeatedly linked to agriculture in many countries (Larned *et al*., 2004).

Freshwater ecosystems are highly prized in New Zealand for their unique species as well as for recreational purposes, and as a source of drinking water for both people and stock. However, this vital resource has undergone significant degradation and continues to show a declining trend in water quality throughout New Zealand. As such, the improvement and guardianship of the country's freshwater systems have become acutely important and are now acknowledged as one of New Zealand's most critical environmental problems (Abell *et al*., 2011; Ramilan *et al*., 2011; Marsh, 2012; Ballantine and Davies-Colley, 2014; Foote *et al*., 2015).

Restoring the ecological function of a landscape is one solution for addressing this growing environmental issue. It also has wider relevance in the field of conservation. Traditionally

conservation has focused on individual rare or endangered species, and is especially true of New Zealand's approach over the years (Wang *et al*., 2004; Ministry for the Environment and Department of Conservation, 2016). Yet, it is becoming increasingly apparent that a species-focused approach to conservation is quickly becoming outdated as the practice is not cost-effective or capable of dealing with the surging, cumulative negative effects being experienced by Earth's ecosystems. Instead it is suggested that an approach which centres on the ecological function of systems would be of more benefit (Ehrenfeld, 2000; Rodriguez *et al*., 2012).

The restoration of ecologically functioning wetlands has proved to be effective for enhancing water quality. A wetland is a landscape which represents an ambiguous, in-between form that is neither only water, nor land, but both (Woodward and Wui, 2001). There are a number of different definitions for describing wetlands. In New Zealand the Resource Management Act 1991 (RMA) describes wetlands as "*permanently or intermittently wet areas, shallow water, and land water margins that support a natural ecosystem of plants and animals that are adapted to wet conditions*" (Ministry for the Environment, 1991).

Wetlands assist in water purification by removing and utilising nutrients which enter their systems. They also filter chemicals, sediments and microbes, and prevent erosion by slowing the velocity of water before it enters connecting water bodies (Ministry for the Environment, 2001; Myers *et al*., 2013; Yepsen *et al*., 2014). It is this vital ability to purify water that has seen wetlands often described as the 'kidneys of catchments' (Gluckman, 2017; Morton, 2018). Wetlands also contribute to other environmental benefits such as carbon sequestration, regulation of atmospheric gases, flood control, and habitat for fauna and flora (many of which are rare species); making them very productive and dynamic systems (Myers *et al*., 2013; Ministry for the Environment and Stats NZ, 2017). For example, rare and endangered New Zealand native species such as the Australasian bittern (*Botaurus poiciloptilus*), Swamp helmet orchid (*Corybas carsei*), and the Canterbury mudfish (*Neochanna burrowsius*) all rely on wetlands to survive (Morton, 2018).

The majority of the land where wetland loss has occurred is privately-owned farms, making farmers the key actors in this matter (Hunt, 2007). Moreover, agricultural activities exert pressure on water resources in farming landscapes. Therefore, to mitigate that pressure it would be logical for farmers to be directly involved in the establishment of wetlands on farms where they have been lost or degraded. Hence, it is important to understand farmers' views on establishing wetlands, including identifying those factors which encourage farmers to restore ecological function, as well as those factors that do not.

A number of scientific investigations have been conducted on the problems of restoring ecological function in agricultural settings. However, it is still not clear how to best marry ecological function restoration and agriculture in a manner which is readily adopted by farmers. Additionally, there is little research on the restoration of ecological function, through wetlands, on farms in a New Zealand context. Therefore, the overall purpose of this research is to build on existing studies by investigating the barriers to, and the opportunities for, restoring wetland ecological function on privately-owned New Zealand farms.

1.2 Research context: New Zealand overview

New Zealand is an isolated archipelago and its unique biota represents important species from the world's biotic history, including species with Gondwanan ancestry (Glasby, 1991; Lindsey and Morris, 2000; Cometti, 2008). Due to New Zealand's long-term isolation after its separation from Gondwana, it has one of the highest levels of endemism in the world, making its species vulnerable and internationally important to protect (Wilson, 2004; Gibbs, 2006; McDowall, 2008; Boyer and Giribet, 2009; Trewick and Gibb, 2010; Turner, 2013).

Since New Zealand's settlement by people during the past 700-800 years, the country has undergone many environmental changes, some caused by biophysical processes like climate change, while many more have been instigated by people. For instance, before human occupation, a large percentage of both the North and South Island (2,471,080

hectares (ha)) was covered by wetlands, however, now only 249,776 ha of wetlands remain (Hunt, 2007; Ministry for the Environment and Stats NZ, 2017; Morton, 2018).

Many New Zealand land modifications have been made to enable the expansion of farming, an occupation which has long been affiliated with the country, and is often described as the lifeblood of New Zealand. During the past 100 years, pastoral land cover in New Zealand has increased from two million ha to approximately 14 million ha (Parliamentary Commissioner for the Environment, 2004; Ministry for the Environment and Stats NZ, 2017). Not only has pastoral land become more extensive but, more importantly, its use has also intensified. For example, between 1994 and 2002 dairy cow herds increased by 34 percent throughout the country but only 12 percent more land was used for dairy farming (Parliamentary Commissioner for the Environment, 2004).

New Zealand agricultural intensification has meant more pesticides, fertilisers, pathogens and animal waste entering the country's waterways via diffuse pollution, be it runoff or infiltration through soil into groundwater (Ministry for the Environment and Stats NZ, 2017). Scientists and government agencies have known for several years that the quality of water adjacent to pastoral areas is often low when considered against the Ministry for the Environment microbiological water quality guidelines and Australian and New Zealand Environment Conservation Council water quality guidelines (Larned *et al*., 2004).

In many instances water quality is unsuitable for drinking and swimming due to pollution from stock faecal matter, algal blooms (resulting from excess nutrients), and poor water clarity due, in part, to sedimentation (from activities such as cultivation and removal of native vegetation). Research has shown that, in New Zealand, water in areas surrounded by pastoral landscapes may have concentrations of *Escherichia coli*, dissolved nitrogen, and phosphorus that are between two and seven times higher than where surrounding land-cover is dominated by native vegetation, as well as having a 40 to 70 percent reduction in water clarity (Larned *et al*., 2004). This is especially true in lowland areas where there has been a growing trend of conversion from low-intensity grazing to intensive dairy production and cropping (Larned *et al*., 2004; Parliamentary Commissioner for the

Environment, 2004). Additionally, many of New Zealand's indigenous freshwater species have come under pressure due to the increasing poor health of their watery habitats (Ministry for the Environment and Stats NZ, 2017).

Commonly wetlands are viewed as wastelands and, consequently, in New Zealand many wetlands have been lost or significantly degraded and modified, with losses still continuing (Ministry for the Environment, 2001). For example, around 95 percent of the country's wetlands have been drained (Figure 1.0), with only 2 percent of wetlands in some regions remaining unmodified (O'Donnell *et al.*, 2015). Figures also show that most remaining wetlands are less than 10 ha and are less likely to be nationally or internationally recognised compared with larger wetlands, leaving them relatively unprotected by legislation (Ministry for the Environment, 2001; McGlone, 2009; Myers *et al.*, 2013; Patterson and Cole, 2013). Together these circumstances make New Zealand wetlands a highly threatened class of ecosystem, which has not only declined in extent but is also highly fragmented (Hunt, 2007; Myers *et al.*, 2013).

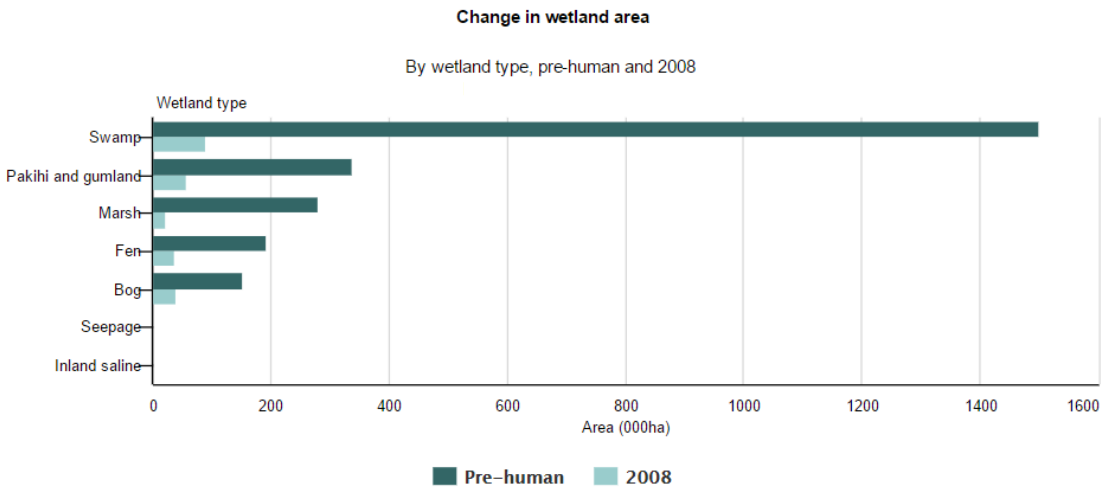


Figure 1.0 Change in wetland area by wetland type, pre-human and 2008 (New Zealand Government, 2017)

Recently, there appears to be a degree of increased awareness and understanding of the ecological and social values of wetlands. Globally this was given impetus by the Ramsar Convention, in 1971, which resulted in the signing of an international treaty that acknowledged the necessity of people to work together, both at national and international scales, to protect wetlands and their associated resources. New Zealand was one of the signatories, thus signifying the country's increasing appreciation of these important

environments (Myers *et al*., 2013). Additionally, in 2012 a New Zealand study estimated that wetlands were responsible for 13 percent of the country's land-based ecosystem services, equating to NZ $8,720 million. Water storage and retention were identified as the most important ecosystem service of wetland systems (Patterson and Cole, 2013).

Overall, while New Zealand's acknowledgement of the significance of wetlands has increased and it has legally recognised the need to protect its wetlands, remaining wetlands continue to come under threat. Many of those wetlands that have managed to remain in existence in modern New Zealand are often assessed as having low ecological integrity and quality (Myers *et al*., 2013). This significant loss of wetlands in New Zealand has compounded the country's substantial decline in freshwater quality, as well as contributed to loss of native fauna and flora, an increase in erosion and flooding due to decreased water retention, and intensification of acute dry periods. Aside from the ecological functionality that has been lost, the cultural and social values associated with wetlands have also been affected (Hunt, 2007).

1.3 Research aim and approach

The primary aim of this research is to investigate the barriers to, and the opportunities for, restoring ecological function on New Zealand farms, using wetlands as a specific example. To achieve this aim the main enabling and constraining influences on ecological function restoration, in both international and New Zealand research literature, were identified. These factors were then analysed to evaluate their relevance to New Zealand wetland establishment, and to identify whether there were any additional influences on the establishment of wetlands in New Zealand.

It is anticipated that this research will provide substantial information on the various factors influencing New Zealand farmers' managerial decisions with regard to restoring wetland ecological function on their properties, as well as illustrate the similarities and differences these factors have compared to wider examples of ecological function restoration. The identification of what enables the restoration of ecological function on farms is intended to assist in the movement towards more proactive policies.

1.4 Research structure

This chapter identified the issue being researched, and the wider context of the study, as well as the specific aim and approach of the research. The complex relationship between water quality, wetlands, and agriculture was explained briefly. Chapter Two highlights the theoretical framework of the study and examines findings from previous research on the issue. Chapter Three discusses how the research was conducted, including details on how primary data was collected through a survey and multiple case studies, which involved semi-structured interviews. Surveys enabled a general overview of the issue and provided the wider context, while the case studies gave more detailed information which was required to encompass the complexity of the research problem. Chapter Four documents the results of the research, which are then discussed in detail in Chapter Five. The thesis is concluded in Chapter Six with final conclusions of the study being drawn.

2. Influences on the restoration of ecological function: a theoretical review

2.1 Introduction

The purpose of this chapter is to understand and evaluate the factors influencing the restoration of ecological function that have been identified in the research literature. To achieve this the chapter begins by discussing what is meant by the restoration of ecological function, followed by an exploration of the broader considerations of ecological function restoration. Then, factors that have been suggested in previous research as influencing ecological function restoration are reviewed, to establish their potential importance in farmers' managerial decisions. The chapter concludes with a theoretical framework to provide a frame of reference for this research.

2.2 What is ecological function restoration?

Establishing what 'restoration' actually means and what exactly is being 'restored' form an underpinning argument in conservation. Broadly speaking there are two ways of viewing ecological restoration. One idea is that conservation should concentrate on reinstating historic ecological patterns (also often referred to as ecological restoration). The opposite end of the spectrum is the idea that emphasis should be placed on the restoration of ecological function in a landscape which is appropriate for the Earth's changing present, and possible future, conditions.

Ecological restoration implies that humans are a separate entity from the natural environment; however, in contemporary research this is often viewed as inappropriate and detrimental to achieving broader environmental goals (Ehrenfeld, 2000; Wang *et al*., 2004; Erwin, 2009). Additionally, ecological restoration may not always be feasible due to factors such as extinctions, changes in climate, social conditions, and incomplete data (Choi, 2004; Nilsen *et al*., 2007; Toledo *et al*., 2011). For example, McGlone (2009) believes that in New Zealand the restoration of wetlands to their condition prior to human settlement is unlikely to be possible due to the significant changes in nutrient and water flows since the arrival of people. Furthermore, the changes that wetlands have undergone are often irreversible;

but even if not, to restore them would come at a substantial and possibly unacceptable cost to society and the economy (McGlone, 2009). Thus, conservation which instead focuses on the restoration of ecological function enables an adaptive approach to be taken that is reactive to unpredictable future changes and responsive to new information, methods and scenarios that materialise (Choi, 2004; McGlone, 2009). Arguably, while the re-establishment of historic environmental conditions may be an impractical and unrealistic goal, these historic patterns can still be used as guidelines and benchmarks for achieving the restoration of ecological function (Choi, 2004; Willis and Birks, 2006). It is the purpose of this research to focus on restoring ecological function on farms, using wetlands as a case study example, and to support farmers in achieving this. Throughout the remainder of this report ecological function will be referred to as EF.

2.3 Broader considerations of EF restoration

There are a number of broad considerations to bear in mind when thinking about EF as a concept and a potential activity. Over the following sections this is explored in more detail.

2.3.1 Society or biodiversity

EF restoration projects on farms can assign differing levels of priority to the enhancement of biodiversity or to human well-being. For instance, some EF restoration projects may focus on creating habitat to increase the number of different native species in an area, and to expand these species' population sizes. In contrast, the aim of other EF restoration projects may be to create reliable and clean sources of drinking water for society. The decision over which approach to use largely depends on the objectives of the programme or project (Callicott *et al*., 1999). However, increasingly in recent times it is recognised that there is an overlap between these two aspects and each aids the improvement of the other. For example, like all other species, people rely on the maintenance of healthy ecosystems and the ecological processes they provide, such as freshwater and food (Hill, 1998; Wang *et al*., 2004; Erwin, 2009; Lagabrielle *et al*., 2010; Okruszko *et al*., 2011; Syrbe and Walz, 2012; Borgström *et al*., 2013). In addition, society is economically dependent on the ecological functionality of environmental systems. For instance, in 1994 it was estimated that biodiversity on land contributed around NZ $44 billion to the New Zealand economy,

equating to nearly half of that year's gross domestic product (Parliamentary Commissioner for the Environment, 2004).

It is reasonable to conclude that there is a synergy between repairing the environment, increasing biodiversity levels and enriching society's well-being. However, the individual circumstances of an EF restoration project, including the perspectives of the people involved and the setting of the ecological site, will ultimately dictate whether biodiversity and the health of society are given equal weighting or if one is given a degree of precedence over the other. Therefore, while motivations of farmers to develop wetlands on their properties may vary on how much significance they place on increasing biodiversity or human health, the outcome will generally be the same.

2.3.2 Scale of EF restoration

The appropriate scale for EF restoration can generally be looked at in two ways. One concept is that the restoration of EF can only address the issue of habitat fragmentation and biodiversity loss if it focuses its energies on large-scale EF restoration (Ehrenfeld, 2000; Wang *et al*., 2004; Borgström *et al*., 2013). In contrast, another perspective is that small EF restoration sites are able to provide fundamental ecosystem services, especially if they are close to one-another (Okruszko *et al*., 2011). A number of studies indicate that 30 percent of a landscape area needs to be re-vegetated with native species for successful ecosystem functionality, a figure that seems to be consistent across a range of different scales and land types (Thompson, 2011; Banks-Leite *et al*., 2014). In addition, like all habitats, wetlands are affected by surrounding land uses, with factors such as dams, surface run-off from agricultural lands, and the removal of plants in riparian areas all affecting these environments and the species which rely on them (Myers *et al*., 2013). This implies that a catchment approach is required to address environmental issues regarding the EF of habitats. Furthermore, small EF restoration areas are more susceptible to external factors and therefore are not as tolerant to adverse effects as larger EF restoration sites. For example, while small wetlands are able to provide important ecosystem functions, a wetland that is not only small but also has high levels of pest species, a low water table,

and suffers from high amounts of sedimentation and nutrient run-off is likely to contribute little to the EF of the area (McGlone, 2009; Myers *et al*., 2013).

However, it is important to recognise that while individual actions may only slightly affect the ability of a habitat to function, the cumulative effect of individual actions can have a substantial, positive influence on ecosystems. These cumulative effects are evident in integrated catchment management plans, where EF restoration in agricultural areas is undertaken at a farming community level (Ministry for the Environment, 2001). Therefore, while larger EF restoration sites are ideal, the development of a series of EF wetlands on individual farms throughout a catchment is still beneficial as they can create a matrix of interconnected environmental refuges.

2.3.3 Bottom-up versus top-down

EF restoration can be carried out as top-down activities, or alternatively take a bottom-up approach. With the former there is more reliance on regulations, while with the latter efforts are driven by individuals or community groups. Whichever approach is taken, there is general agreement that for the restoration of EF on farms to be effective it requires the support of farmers (Attwood *et al*., 2009; Fisher, 2012). This is especially true in privately-owned, agricultural settings as environmental policies can encounter problems such as threats to private property rights, as well as the exclusion of valuable landowner knowledge (Merenlender *et al*., 2004; Lagabrielle *et al*., 2010; Halbrendt *et al*., 2014). As Hill (1998) notes, the concept of being legally obliged to manage one's land in an environmentally-conscious manner can be interpreted to mean a restriction on the landowner's free will, and it is this loss of freedom of behaviour that is thought by some to have caused the general failure of institutionalised environmental land management (Hill, 1998).

However, some non-regulatory mechanisms struggle to achieve their objectives. For example, the Dairying and Clean Streams Accord in New Zealand (now replaced by the Sustainable Dairy Water Accord) aims to guard the integrity of wetlands, streams and other waterbodies from the negative effects posed by dairying practices, by farmers voluntarily

fencing waterways and controlling farm run-off. Unfortunately, to date many of the targets set by the accord have not been met (Bewsell *et al*., 2007; Rowarth, 2013). As such, it is suggested that while voluntary environmental codes in industries are important, the amount of work that is necessary to amend New Zealand's poor freshwater quality situation is too large to be met without some level of regulation (Gluckman, 2017). Additionally, it has been suggested that stronger legislation is required for the protection of highly threatened environments, such as wetlands, and is particularly true if the farmer does not experience an increase in profitability as a result of an environmental action and/or they do not have adequate resources for EF restoration projects (Holland, 2014). Furthermore, it has been found that those countries which have a national wetland policy, or an equivalent regulation, have wetlands with higher levels of EF (Myers *et al*., 2013). Overall, this implies that an approach which is driven by the farming community but supported by regulations may prove the most effective means for restoring EF wetlands on farms.

Community-based catchment plans, which include both farmers and the wider community, are one way to combine bottom-up and top-down approaches by involving those affected by the environmental concern in the process of addressing the issue. In this manner traditional local knowledge, along with scientific data, can be used to create more holistic policies (Parliamentary Commissioner for the Environment, 2004). This suggests that an approach which is driven by farmers in partnership with the wider community is highly beneficial for establishing EF wetlands on farms. Additionally, the inclusion of local people in the planning of environmental policies helps to ensure that legislation is relevant to the area that it is intended for, by responding to site-specific issues. Moreover by involving the wider community in the planning process, they are also more likely to be committed to the environmental initiatives they have had a part in (Myers *et al*., 2013). It is widely recognised that stakeholders need to work together, including farmers, iwi, the public, and local authorities, to restore EF, pointing to the importance of bottom-up EF wetland developments on farms, supported by top-down approaches (Badgley, 2003; Wynne-Jones, 2013; Halbrendt *et al*., 2014; Quinn *et al*., 2015; Gluckman, 2017).

2.3.4 Institutional setting

The wider institutional setting in which environmental projects take place can be either supportive or non-supportive of EF restoration. This can influence the establishment of EF wetlands on farms and, hence, wetland development cannot be considered in isolation from institutional environments. For instance, in most places in the world farmers are rewarded based solely on their productivity, with little reward given to those that strengthen ecological systems through sustainable land management, such as by conserving water and soil. This is because the global economy is focused on short-term profits, rather than the long-term maintenance of the system of resources on which the agricultural industry relies (Schaller, 1993; Badgley, 2003; Pechlaner, 2010).

It is argued that changes in thinking are required by governments, producers, and consumers if the issue of degrading water quality and its link to agriculture is to be adequately addressed (Hill, 1998). There has been some increase in the recognition of sustainable agriculture, with several companies running programmes which reward agricultural suppliers that meet environmental standards by selling their produce at a premium. For example, European retailer Marks and Spencer provide premium prices for lamb if farmers are able to verify that the meat was produced using sustainable production methods and farm management (Ministry for the Environment, 2001). However, while this is a positive step, it is yet to be enough to address many countries' ailing water health. For instance, recently, the Organisation for Economic Cooperation and Development (OECD) stated that New Zealand's environment is suffering due to the country's economy becoming increasingly, and heavily, reliant on primary industries. The current trade-off between New Zealand's environment and its economy is not sustainable in the long-term for either aspect. As such, it has been recognised that if New Zealand is to adequately address its water quality issues then core aspects of the country's economic policies need to be reviewed (Gluckman, 2017). Overall, by evaluating the institutional setting in which wetland establishments on farms sit, fundamental patterns of institutions can be questioned and solutions for developing EF wetlands on rural properties can be found outside of existing political restraints (Rangan and Kull, 2009; Quandt, 2016).

2.3.5 Conclusion

There are many approaches to conservation, however, the focus of this research is on EF restoration of wetlands of all scales, which take a bottom-up approach, and that have been undertaken for a variety of reasons. Furthermore, in New Zealand because institutional arrangements are not particularly supportive, there is a strong reliance on the farming community for initiating the development of wetlands on farms. Therefore, to foster the creation of wetlands it is necessary to look at the wider political context in which these projects sit. The following sections of this chapter explore the various factors that research suggests can enable or limit EF restoration. By understanding the influence of these factors it is then possible to look at ways to encourage more farmers to develop wetlands on their properties.

2.4 Factors of influence

Farming systems are dynamic and as such agricultural decisions are complex in nature, requiring multilateral analysis and adaptive, pragmatic solutions. Previous studies have identified a broad model of how farmers view and respond to restoring EF on farms. Specifically, it has been found that the interrelationships between land characteristics, personal characteristics, social networks, knowledge, technology, economics, institutional and structural arrangements, and farm characteristics can have a profound influence on farmers' managerial decisions (Figure 2.0). Often when establishing the motivating factors behind farmers' decisions to restore EF on their land, it is useful to think of individual farms as its own system of people, produce, ecological functions, and this system's place in its wider social, economic, and environmental setting (Barr and Cary, 2000; Ministry for the Environment and Department of Conservation, 2016).

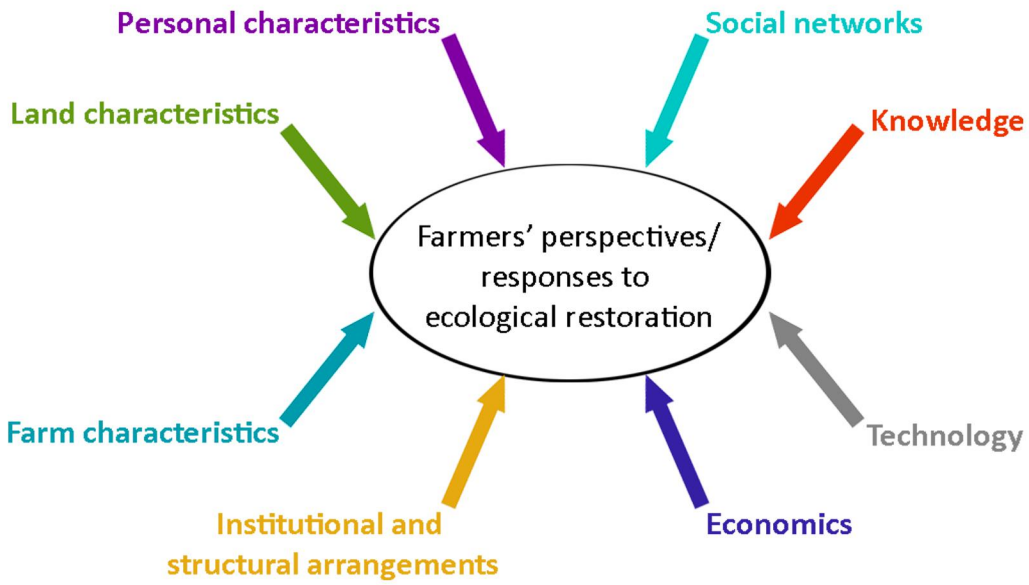


Figure 2.0 Broad model of factors influencing farmers' decisions towards EF restoration

2.4.1 Land characteristics

Land characteristics refer to the physical geography of a farm, including aspects such as weather, hydrology, soil conditions, and topography. These characteristics can be influential on farmers' adoption rates of EF restoration (Wilson, 1992; Kristensen *et al.*, 2001; Welsch, 2011; Fisher, 2012; Halbrendt *et al.*, 2014; Smith and Sullivan, 2014). For example, the different climatic conditions for farming in Australia and New Zealand contribute to different EF restoration practices in each of these countries. Agriculture in Australia is largely non-irrigated and reliant on rainfall and as such farmers there need to have a specific focus on conserving their soil-water balance. However, as New Zealand has a higher level of rainfall and farmers there are able to use irrigation, there is lower perceived need to conserve water, making it less of a priority for New Zealand farmers (Kaine and Johnson, 2004; Ward and Siddique, 2015).

The presence of marginal areas of low productivity, such as steep gullies and forest edges, can have a positive effect on the restoration of EF as there is a reduced risk of economic trade-off for the landholder, lower establishment costs for EF restoration, and possible added benefits, such as erosion control (Battershill and Gilg, 1997; Wilson, 2000; Wilson and Hart, 2001; Walford, 2002; Lynch and Lovell, 2003; Berger *et al.*, 2006; Scherr and McNeely, 2008; Carlisle, 2016). For instance, Wilson (1992) undertook a study in the Catlins

District of New Zealand to investigate farmers' attitudes towards remnant native forests on their lands. Wilson surveyed a number of farmers in the area and examined the potential influences on their behaviour. The study indicated that the major reason native bush still existed on farms in the area was because of steep topography, which meant the land was excluded from farming (Wilson, 1992). A similar New Zealand study undertaken in Canterbury, explored the influences on farmers' perceptions towards re-establishing native vegetation on their properties. It was found that sheep farmers had more native bush on their properties, due, in part, to the rolling hills on their high country farms (Welsch, 2011).

Overall, it is apparent that land characteristics influence farmers' decisions about restoring EF on their properties. However, it appears that farmers only restore EF on their farms in response to specific land characteristics if it works with their current farming practices and preferably provides an economic return. Therefore, while certain land characteristics increase the likelihood of farmers adopting EF restoration on their farms, this factor does not appear to significantly affect farmers' attitudes towards restoring EF.

2.4.2 Personal characteristics

Personal characteristics include factors such as a farmer's age, beliefs, and attitude. Age is an aspect of personal characteristics which is commonly suggested as being highly influential on farmers' adoption of EF restoration. Overwhelmingly, it has been found that as a farmer's age increases their interest in EF restoration schemes decreases, and therefore it is considered that younger farmers are more likely to be open to restoring EF on their farms (Wilson, 1992; Dunlap *et al.*, 2000; Söderqvist, 2003; Duke, 2004; Langpap, 2004; Gan *et al.*, 2005; Ahnström *et al.*, 2008; Rodriguez *et al.*, 2012; Ashraf *et al.*, 2015). Interestingly, a minority of research indicates that while age still has some effect on farmers' decisions towards EF restoration, it is not a significant influence and its importance in decision making is not well understood (Wilson, 1997; Pannell *et al.*, 2006; Welsch, 2011).

A farmer's opinions and beliefs can also have a significant influence on how they perceive an environmental issue and, in turn, affect adoption rates of EF restoration on farmland (Cocklin and Doorman, 1994; Barr and Cary, 2000; Welsch, 2011). For example, a study

exploring the long-term issue of salinity from irrigation in the Tragowel Plains of Australia found that because salinity had been an issue for many years in the area it had become accepted as the norm, and farmers had become desensitised to the problem. However, in areas nearby where salinity had just become a problem, the farmers were more sensitised to the land degradation and were more inclined to address the issue. This indicates that if farmers believe there is an issue with the environment they are more likely to become involved in environmental initiatives (Barr and Cary, 2000).

The need to recognise land management goals and motivations when encouraging farmers to adopt EF restoration is important, and it is suggested that ecological aims need to be in line with farmers' broader objectives for their farms (Schrader, 1995; Cary and Wilkinson, 1997; Wilson, 1997; Söderqvist, 2003; Pannell *et al*., 2006; Ahnström *et al*., 2008; Fisher, 2012). Barr and Cary (2000) highlight that by aligning EF restoration objectives with the goals of individual farmers it is much more likely this will instil self-reliance in farmers restoring EF. They also believe that motivation levels of farmers is a significant influence, and suggest changes in farm management will not occur until farmers have adequate interest in EF restoration (Barr and Cary, 2000). Likewise, a study undertaken by Erickson *et al.* (2002) on landowner attitudes towards woodlots in the United States emphasises the importance of environmental advocates recognising the motivations that people have for owning wooded areas and how they value them. Similar results were found in Welsch's Canterbury study, which found that re-vegetation is only likely to occur when farmers' motivations increase to an appropriate level (Welsch, 2011).

It is apparent that there are a number of personal characteristics which influence farmers' decisions towards EF restoration. While, in general, it is considered that age is a significant factor of influence, this may not be the case for all EF restoration situations and, thus, its effect should be examined for individual circumstances. In addition, if a farmer believes that an environmental issue exists then they will be more inclined to restore EF. Most importantly, farmers need to be motivated to undertake restoration of EF and this is only likely to occur if farmers perceive that it will enhance the achievement of their personal goals.

2.4.3 Social networks

A farmer's social context can influence their perceptions, motivations and attitudes towards restoring EF, as well as provide valuable sources of information on environmental initiatives. Farmers' social networks are influential at a range of scales, including nationwide farming cultures, organisations, local and farming communities, and farmers' peers and families (Warriner and Moul, 1992; Cary and Wilkinson, 1997; Wilson, 1997; Hatcher *et al.*, 2000; Kristensen *et al.*, 2001; Jackson-Smith *et al.*, 2005; Sorice *et al.*, 2011). In general, EF restoration methods that have higher compatibility with existing ideologies of farming appear to have greater probability of being implemented. Attributes commonly considered by many countries' farming cultures as part of a good farming community include farming which is pragmatic and independent, the operation of 'tidy' farms with well-maintained infrastructure such as fences and gates, as well as crops and stock that look healthy. Interestingly, profitability is not necessarily seen as an indicator of good farming practice, though neither is the presence of sustainable practices (Carr and Tait, 1978; Barr and Cary, 2000; Pannell *et al.*, 2006).

Organisations play a pivotal role in influencing farmers' decisions towards restoring EF. For instance, it has been found that farmers who undertake EF restoration on their farms often require ongoing support in the form of monitoring, maintenance and funding. As such, those farmers who are well supported by organisations are more likely to continue to care for their restoration projects as well as carry out more environmental initiatives on their properties (Pannell *et al.*, 2006; Attwood *et al.*, 2009; Smith and Sullivan, 2014). Organisations which are trusted by farmers are more successful at providing ongoing support as farmers are more willing to adopt the practices that these organisations suggest. Good levels of communication between organisations and farmers is an important means for increasing trust levels (Rodriguez *et al.*, 2012; Stuart and Gillion, 2013; Halbrendt *et al.*, 2014).

Attitudes and actions of local and farming communities can affect the adoption of EF restoration on privately-owned rural properties. For example, one way in which local communities influence the adoption of EF on farms is through the products they consume.

It is thought that for farmers to make successful sustainable changes, environmental values need to be shared by both farmers and local consumer markets (Parliamentary Commissioner for the Environment, 2004; Ministry for the Environment and Department of Conservation, 2016). In addition, it is particularly important for farmers in the same catchment to share environmental goals as land and water do not recognise property boundaries and therefore the environmental condition of one property can affect that of others in the surrounding area (Schrader, 1995; Erickson *et al.*, 2002; Lubell *et al.*, 2002; Pannell *et al*., 2006; Fisher, 2012; Ward and Siddique, 2015). This is exemplified by a water quality study undertaken in Canterbury, New Zealand, which identified that a catchment approach involving the entire farming community was necessary for water standards to be improved (Ministry for the Environment, 2001). However, it is also suggested that while there is a need for farmer cooperation, farming community initiatives, such as land-care groups, are beneficial but tend to only generate incremental changes. This raises questions over acceptable time periods for these changes to occur and methods for improving timeframes of adaptation (Barr and Cary, 2000).

Peer pressure is an aspect of a farmer's social network which can have a positive influence on their implementation of EF restoration. For instance, a study carried out in Uganda revealed that many farmers were successfully encouraged by conservation-minded neighbours to restore EF on their land, with the adoption of EF restoration taking place due to peer-to-peer influence throughout the neighbourhood (Fisher, 2012). Peer support is crucial as farmers are more trusting of those who are not "outsiders". It is also a fundamental way to reduce the perceived risk of restoring EF, with farmers being more likely to restore EF when they are able to see successful examples of EF restoration by other farmers, especially their neighbours (Wilson, 1997; Pannell *et al*., 2006). This emphasises the important role farming leaders play in encouraging EF restoration in the farming community.

In general, family represents the most significant influence in a farmer's social network (Carr and Tait, 1978; Battershill and Gilg, 1997; Lynne *et al*., 1998; Eriksen *et al*., 2011). Although farmers may be influenced by their wider social circle, when they are making

major decisions in regard to farm management, family is the most influential, providing both intellectual and emotional support. For example, it has been shown that farmers consult family members when making choices about farm management and joining environmental schemes (Wilson, 1997; Barr and Cary, 2000). Family has also been found to be especially influential if family members rely on the farm for financial security. Thus, if a change in the management on the farm is deemed to be financially risky, then the likelihood of it being adopted by the farmer is diminished (Barr and Cary, 2000). Additionally, while research generally shows that older farmers are less inclined to carry out EF restoration on their land, if it is the farmer's intention to pass the land on to the younger generations in their family then they are more likely to be interested in restoring EF on their farm (Pannell *et al*., 2006).

Overall, community norms and expectations, as well as support from organisations, peer pressure, and family influences can all be instrumental in determining how farmers form their individual goals and make decisions about their land. While it is easiest to restore EF by working within existing farming ideologies, it appears that this existing framework of farming can be challenged if enough individuals in the farming community, as well as the wider community, support changes to farming cultures. Pressure from farmers' peers and their families are likely to be the most effective connections in their social networks for instigating changes to current farming practices and, thus, increasing the implementation of EF restoration on farms.

2.4.4 Knowledge

Knowledge of environmental issues, such as sensitivity to land degradation and awareness of poor water quality, as well as their level of formal education have been identified as affecting farmers' adoption of EF restoration (Schrader, 1995; Cary and Wilkinson, 1997; Pyrovetsi and Daoutopoulos, 1997; Anim, 1999; Barr and Cary, 2000; Bewsell *et al*., 2007). For instance, in many circumstances the implementation of EF restoration by farmers is largely dependent on their ability to link restoration with on-farm benefits (Pannell *et al*., 2006). When education is used as a tool to connect farmers to their local ecological systems it often results in their heightened interest in these systems. For example, studies on

riparian restoration have found that farmers who are unaware of the linkages between on-farm practices and water quality, and who do not have a strong connection with the streams on their property or do not utilise water resources outside of the farm, are less likely to implement riparian management programmes. In contrast, those farmers who are able to identify and comprehend the issue of water degradation, its causes, and the benefits of taking protective action, show a higher tendency to invest in protecting water quality through riparian management (Rhodes *et al.,* 2002; Bewsell *et al*., 2007).

Additionally, it has been found that farmers are often unaware when water quality is poor in their surrounding environment, and by undertaking ongoing monitoring on these local waterbodies and showing the community the results, it can increase farmer interest in the maintaining the health of their local streams and water systems (Ministry for the Environment, 2001). As part of this, farmers are able to learn about the aquatic species that live in these systems, which helps to motivate them towards caring about their local ecological systems. It is also thought if farmers are made aware of how pollutants from farming systems actually enter the water, and that the negative impacts they are having are properly understood, then farmers' invested interest in protecting the health of their local waterways would markedly improve (Ministry for the Environment, 2001). Overall, it is suggested that this acknowledgment by farmers of the environmental benefits of EF restoration is necessary to instigate long-term behavioural changes and thus ongoing environmental gains (Pannell *et al*., 2006; Eriksen *et al.*, 2011; Rodriguez *et al*., 2012; Smith and Sullivan, 2014; Ashraf *et al*., 2015).

Farmers who have been involved in previous environmental work are also more likely to have increased levels of environmental awareness, as well as be more open to involvement in further environmental schemes. This is often true because farmers have directly experienced benefits from previous EF restoration schemes they have implemented (Ministry for the Environment, 2001; Arano *et al*., 2004; Gan *et al.,* 2005; Jellinek *et al*., 2013; Halbrendt *et al*., 2014; Carlisle, 2016). For example, research on endangered species conservation in North Carolina, in the United States, found that farmers were more than

twice as likely to show an interest in incentive programs for endangered species if they had previously participated in environmental projects (Rodriguez *et al*., 2012).

In general, higher levels of formal education greatly increase the odds of farmers implementing environmental initiatives on their properties (Wilson, 1997; Jackson-Smith *et al*., 2005; Pannell *et al*., 2006; Welsch, 2011). For example, Ashraf *et al*. (2015) undertook a study in Utter Pradesh, India, where they surveyed farmers to find out which factors were influencing them when deciding to plant trees on their farms. It was found that lower levels of education was one of the main reasons that farmers were less inclined to plant trees on their rural properties. Interestingly, a small number of studies have found that formal education is not always a strong determinant on farmers considering the restoration of EF (Wilson, 1997), suggesting that informal forms of knowledge should also be considered when ascertaining the influence of knowledge on farmers' decisions regarding EF restoration. For instance, information is typically sought by farmers from a range of sources, including consultants, stock agents, representatives from agricultural companies, and other farmers (Barr and Cary, 2000). Readily accessible information on the restoration of EF from informal sources can improve information uptake by farmers who often have limited time for further education (Barr and Cary, 2000).

In all, those farmers who have a sound understanding of environmental issues and the linkages between these and farming practices are often more open to the concept of EF restoration. Previous exposure to environmental schemes is an effective means for increasing this understanding of local ecology and its connections with farming. Formal education can increase the likelihood of EF restoration on farms but it appears that those farmers who have lower levels of formal education are still likely to restore EF if they have learnt good environmental awareness through personal experiences or by accessing information in their social networks.

2.4.5 Technology

Technology has been identified as an influential factor when farmers are deciding whether to restore EF on their properties as the potential technological complications of an

environmental initiative can often deter farmers from carrying out such work (Kaine and Johnson, 2004; Ahnström *et al*., 2008; Okruszko *et al*., 2011; Halbrendt *et al*., 2014). Examples of technology include the use of alternative crops to reduce reliance on water (such as planting lucerne in dryland areas), changes to tillage methods to reduce erosion and improve soil structure, and the implementation of wetlands to improve water quality.

The four fundamental aspects of technology which can lessen its adoption include low compatibility with existing managerial operations; the technology is unable to be trialled at a small scale before being implemented in full; the benefits from the technology are not easily observed; and the suggested technology is complex. Additionally, farmers are less likely to restore EF if necessary information or materials for the implementation of the technology are not available (Wilson, 1997). Furthermore, it is important to involve farmers in the development of these technologies to increase the likelihood of farmer implementation (Cary and Wilkinson, 1997; Barr and Cary, 2000; Pannell *et al*., 2006). Overall, the influence of technology is mentioned frequently in the research literature but it does not appear to have a significant effect on farmers' managerial decisions when compared to other factors, such as personal characteristics and social networks.

2.4.6 Economics

Economics are widely discussed in the research literature and are largely believed to have a significant influence on farmer adoption of EF restoration (Barbier, 1990; Wilson, 1992; Cocklin and Doorman, 1994; Wilson, 2000; Yiridoe *et al*., 2010; Welsch, 2011; Trevisan *et al*., 2016). In general, it is argued that concern for the environment is often of little or no concern in farmers' managerial decisions, with economics comprising the main motivating influence. For example, Bewsell *et al.* (2007) found that the protection of stock was the most significant factor in safeguarding and managing riparian areas. Additionally, in both Australia and the United Kingdom it has been found that EF restoration is regarded as of less importance for those farmers who are more constrained by finances, and that environmental initiatives need to increase economic gains over existing farm practices if they are to bring about environmental-behavioural change in farmers (Cary and Wilkinson,

1997). This suggests that restoration of EF is more likely to occur if the enhanced monetary benefits of EF restoration over current farm practices are clearly illustrated to farmers.

Short-term economic benefits of EF restoration have a strong influence on the decision to restore EF in agricultural settings as not all farmers are in a situation to be able to consider long-term profits, with immediate financial constraints being more pressing (Barr and Cary, 2000). Therefore, without the promise of economic returns in the short-term there is often a reduction in farmers' adoption of environmental initiatives, and environmental-behavioural changes become harder to instigate (Cary and Wilkinson, 1997; Barr and Cary, 2000; Pannell *et al*., 2006). However, the economic risk of environmental schemes is lessened for those farmers who are able to supplement on-farm incomes with off-farm earnings as incomes generated off the farm can assist in counter-balancing the potential loss of productive land as a result of EF restoration efforts, and reduce financial reliance on the farm (Barr and Cary, 2000; Pannell *et al*., 2006; Welsch, 2011; Jellinek *et al*., 2013; Jellinek *et al*., 2014).

The economic value of a farmer's property is an important consideration when attempting to understand farmers' behaviour with respect to EF restoration. For example, if agricultural property increases in value any land that is set-aside for environmental purposes comes at a high cost because of the increased land value. In addition, those farmers who are establishing their farming businesses often have less disposable income as their debt levels are generally higher, and is especially true if land prices increase. This compels new farmers to adopt intensive farming operations with high production levels as a way to pay off their debts more quickly (Parliamentary Commissioner for the Environment, 2004). In contrast, those farmers who have been on their land for longer periods of time, such as on intergenerational farms, and own (rather than lease) the farms they operate, are usually more financially secure and therefore more open to EF restoration (Wilson, 1992; Wilson, 1997; Walford, 2002).

Access to funding has been identified as affecting the implementation of EF restoration, and is generally believed to be a necessary attribute for the success of EF restoration on

farms (Rhodes *et al.*, 2002; Wade *et al*., 2008; Attwood *et al*., 2009; Welsch, 2011; Jellinek *et al*., 2013; Holland, 2014). For instance, in Ashraf *et al*.'s (2015) study in India, it was found that short-term monetary incentives were influential on the adoption of re-foresting farms, with state subsidised seedlings and government support resulting in increased farm forestry. It is argued that one of the reasons farmers are resistant to EF restoration on their land is because of an increasing lack of financial support from governments for activities such as riparian retirement and erosion control, while simultaneously, the profitability of farming is dropping (Ministry for the Environment, 2001). Even if farmers are willing to make environmental changes if they do not have the required resources accessible to them then adoption of EF restoration is unlikely to occur.

A small number of studies conclude that economics are not always the main influence on farmers' managerial decisions. For example, while farmers often mention economics as being influential on their decisions regarding EF restoration, it is possible that there is a more complex interplay of factors influencing their decisions (Carr and Tait, 1991; Ahnström *et al*., 2008). Ryan *et al*. (2003) found that although farmers were motivated by economics to protect riparian areas on their properties, internal motivations, such as beliefs and attitudes, were more important motivators in implementing environmental schemes.

In summary, economics is widely regarded as the most significant factor influencing farmers' decisions regarding EF restoration and is less likely to occur if restoring EF involves high establishment costs, only long-term benefits, high financial risk, results in the loss of agriculturally productive land, and causes a net economic loss for the farmer. It is suggested that even if farmers are willing to restore EF if they do not have the finances to undertake the work then they will not restore EF on their farms. Farmers are more likely to restore EF if they have less debt and are more established in their farming businesses. However, it appears that in some EF restoration schemes financial constraints can be overcome by farmers' attitudes, thus, suggesting that economics may have differing levels of influence on various environmental initiatives.

2.4.7 Institutional and structural arrangements

Institutional and structural arrangements have been found to affect farm management. Incentives, counter-incentives, and regulations are some of the ways which institutional and structural arrangements influence farmers' adoption of EF restoration (Kristensen *et al*., 2001; Pannell *et al*., 2006; Welsch, 2011). For instance, in the mid-1980s the New Zealand government removed farming subsidies and opened the country's agricultural sector to international competition. In response, farmers targeted international markets and began focusing largely on exporting their produce. As a result of having to be competitive internationally, economic productivity became the overriding ambition of many farmers (Parliamentary Commissioner for the Environment, 2004). This arrangement has continued into the present and still represents the dominant agricultural policy of central government. In addition, the New Zealand government only uses light-handed enforcement for environmental protection, especially when compared to other OECD countries. In New Zealand "*the carrots are not always obvious and the stick has been relatively non-existent*", (Parliamentary Commissioner for the Environment, 2004) and, therefore, there is little institutional incentive to restore EF on agricultural properties. It is suggested that environmental policy objectives are likely to be achieved more successfully if they combine regulations with rewards and penalties (Barr and Cary, 2000).

It is important for policies on EF restoration to reflect changing structural arrangements in the agricultural industry. For example, in Australia many farms are becoming larger in acreage and corporately owned. Those that work the land often experience an increase in pressure to keep up with production demand, which can consequently cause detrimental effects to the environment (Barr and Cary, 2000). While institutional and structural arrangements affect farmers' decisions regarding EF restoration, policies are unlikely to be sufficient to alter farmers' attitudes towards EF restoration without the influence of other factors (Cary and Wilkinson, 1997; Wilson, 1997; Barr and Cary, 2000; Bewsell *et al*., 2007). Policies need to be written in a way which reflects the heterogeneity of farming communities by being flexible and adaptable so that they remain responsive to varying circumstances and changing situations (Barr and Cary, 2000).

Overall, institutional and structural arrangements form the wider context in which farmers make their managerial decisions, and thus can influence their decisions regarding the restoration of EF. It appears that the most effective change to institutional and structural arrangements for encouraging more farmers to restore EF is to create policies that balance incentives and regulations. However, even when institutional and structural arrangements are well-designed for encouraging the restoration of EF, farmers still need to be motivated to undertake the work, and hence institutional and structural arrangements alone do not appear to be sufficient without the influence of other factors to instigate the adoption of EF restoration on farms.

2.4.8 Farm characteristics

Farm characteristics, such as property size, type of agricultural operation and stocking intensity, have been identified as affecting the implementation of environmental initiatives on farms (Wilson, 1992; Kristensen *et al*., 2001). In general, the establishment of EF restoration areas in agricultural settings is significantly influenced by farm size, with farmers who operate high-acreage properties being more open to EF restoration (Wilson, 1997; Walford, 2002; Lynch and Lovell, 2003; Söderqvist, 2003; Duke, 2004; Langpap, 2004; Gan *et al*., 2005; Lahmar, 2010). For instance, Welsch (2011) found that those farmers with larger acreage tend to have more expanse of native bush on their properties, as owners of smaller farms are more focused on production. On the other hand, it was also found that property size had no effect on the presence of bush on dairy farms, with native vegetation always being minimal on these properties (Welsch, 2011). It is possible that this reflects the tendency for dairy farms to be on flat land without gullies, which are common areas for bush remnants. Welsch (2011) noted that beef and sheep farmers showed higher levels of environmental concern, while dairy farmers displayed a greater tendency to have a utilitarian approach. This suggests that the type of agricultural operation and stock intensity may have a greater influence on farmers' managerial decisions than the size of their land. Similarly, a number of studies suggest that certain types of environmental work, such as conservation tillage, are not affected by farm size (Pannell *et al*., 2006).

While some farm characteristics, such as large farm size, can assist in encouraging farmers to restore EF it appears that these are not consistently influential for all EF restoration schemes. In general, the research literature places less emphasis on farm characteristics when compared to the other factors discussed in this section.

2.5 Conclusion

Eight main factors are consistently identified as influencing farmers' decisions over the restoration of EF on their farms (Table 1.0). In general, economics is seen as the most significant factor but as the financial risk of restoring EF becomes greater and uncertainty increases, then factors other than economics start to play a part in influencing farmers' decisions. Farmers more likely to carry out EF restoration tend to be characterised by some or all of the following: are younger and more open to taking risks, have support from government and non-government bodies (as well as their families and peers), have high levels of education, are financially secure and have more resources to draw on, and own large intergenerational farms. In contrast, farmers less likely to undertake EF restoration on their farms are distinguished by some or all of the following: are older, have highly productive land, lack support from their social networks, possess low levels of environmental awareness and have limited formal education, have no past experience with EF restoration, are financially insecure with no alternative incomes, lack funding, and lease small farms.

The purpose of this research is to explore whether these eight main factors apply to the establishment of EF wetlands on farms in New Zealand, and to examine the relative importance of each. This will provide a basis for developing strategies to encourage more farmers to consider EF restoration through wetlands on their farms. The following chapter discusses the research methods that were used to examine the influence of these factors.

Table 1.0 Main factors enabling or constraining EF restoration on farms

Type of Factor	Main enabling factors	Main constraining factors
LAND CHARACTERISTICS	Farm with large areas of low agricultural productivity	Farm with large areas of high agricultural productivity
PERSONAL CHARACTERISTICS	Younger age bracket	Older age bracket
	EF restoration aligns with farmer's goals	EF restoration does not help farmer achieve their goals
SOCIAL NETWORKS	Environmental initiatives are part of the national farming culture	EF restoration is not considered in the national farming culture
	Receive on-going support from organisations	Experience a lack of support from organisations
	Environmental values are shared by others in the community	Lack of shared environmental values in the community
	Support from peers	Lack of support from peers
	Close proximity to others undertaking EF restoration	No exposure to others undertaking EF restoration
	Supportive family	Lack of support from family members
	Environmental group membership	No environmental group membership
	Government and community pressure	Lack of pressure from outside groups
KNOWLEDGE	High levels of environmental awareness	Disconnection with the environment
	Aware of the on-farm benefits of EF restoration	Lack of understanding of the on-farm benefits of EF restoration
	Awareness of the link between agricultural practices and the environment	Farmer does not connect their farm practices with the environment
	Previous participation in EF restoration	No previous interest in EF restoration
	High levels of formal education	Lack of formal education
	Exposure/access to information	Absence of readily accessible information on EF restoration
TECHNOLOGY	EF restoration is easily implemented with existing farm practices	EF restoration requires substantial effort and is complex
	Environmental initiative can be trialled at a small scale first	Environmental initiative is not able to be trialled at a small scale
	The benefits of EF restoration are easily observed	The benefits of EF restoration are not obvious
	Involvement of the farmer in the development of the environmental initiative	No involvement of the farmer in developing the environmental initiative
ECONOMICS	Financially secure	Financial constraints
	Restoration of EF is low risk financially and results in increased net economic return	Restoration of EF is high risk financially, has high establishment costs, and causes a loss in agricultural production
	Immediate and long-term financial returns from EF restoration	Only long-term economic benefits from EF restoration
	Off-farm income	Farm is the sole source of income
	Well-established/ intergenerational farm	Short time spent farming on the property and/or in the area
	Support/funding from organisations and groups	Constrained access to implementation materials, with lack of assistance
	Landowners	Tenants with lack of tenancy security
INSTITUTIONAL AND STRUCTURAL ARRANGEMENTS	Flexible policies that have a balance between regulation and incentives	Prescriptive polices which lack both enforcement and incentives
FARM CHARACTERISTICS	Lower stock rates	Higher stock rates
	Beef and sheep farm	Dairy farm
	Large farm	Small farm

3. Research Methods

3.1 Introduction

This chapter details the research methods and analytical processes employed to explore farmers' perspectives towards actively enhancing or establishing wetlands on their farms. To understand the factors influencing farmers' decisions towards wetland development it was evident that the best approach was to contact farmers directly. In addition, to obtain further useful insights a number of other people involved in wetland establishment on farms were also consulted. It was the objective of this research to provide a broad overview of wetland development on farms at a national scale, therefore a survey in the form of an online questionnaire was utilised, which explored why some farmers have established wetlands while others have not. However, while the survey was able to address the research issue at a wide scale it did not provide detailed information and as such multiple case studies with semi-structured interviews were also used. In contrast to the survey, case studies were limited in their ability to give extensive oversights of factors influencing wetland establishment on farms but instead were able to provide detailed and descriptive information, which could then be contextualised and validated by the survey.

3.2 Survey

Surveys are an appropriate method for learning about self-reported beliefs or behaviours, and are particularly beneficial for gathering core data in a cost-effective and efficient manner from a large number of people. In addition, surveys focus on reliability, assisting researchers to make generalisations from their findings and, therefore are considered advantageous for triangulating data (Bryman, 2001; Neuman, 2011; Halperin and Heath, 2012). In this research, a survey was employed to give a general overview at a national scale of what enabling and constraining factors farmers faced in relation to wetland establishment. Previous studies on EF restoration have employed surveys to elicit both descriptive information, such as age and incomes, and attitudinal data, including farmers' views on endangered species conservation (Rhodes *et al*., 2002; Stuart and Gillion, 2013). A similar approach was utilised for the survey in this study and a copy of the questions asked is in Appendix A.

3.2.1 Survey data collection and analysis

An online survey was employed for this research as it was the most appropriate solution due to its low administrative costs and as it can be conducted by one researcher. Online surveys are also convenient for the respondent because they can complete the survey in their own time and they offer anonymity, as well as avoiding interviewer bias (Bryman, 2001; Neuman, 2011). Self-administered surveys, such as online questionnaires, do have the disadvantage of lower response rates; however, this can be overcome by designing the survey in a manner that is easy to understand and answer (Bryman, 2001; Neuman, 2011).

The survey for this research was designed and administered using the online program RedCap (Harris *et al*., 2009), and primarily used closed questions. Closed questions were preferred where possible as they have the advantage of being pre-coded, thus, reducing uncertainty and resource constraints which can arise from post-coding. Attitudinal variables were measured on a Likert scale, while descriptor questions were in a multi-choice format. In addition, some questions were scored in reverse to avoid the problem of response bias, where participants display a tendency to answer every question in a series with the same response (Neuman, 2011). Careful consideration was given to ensuring that the questions were set in a logical sequence and that more sensitive questions were placed towards the end of the survey. Furthermore, the survey was piloted to remove ambiguity and increase its reliability (Bryman, 2001; Neuman, 2011).

The survey was advertised over a three week period by a number of New Zealand farming organisations via newsletters, websites, and social media. Organisations were selected based on their broad audience which included farmers from a range of agricultural industries nationwide. This approach was used as there is no accessible sampling frame, such as a public database of New Zealand farmers, from which to obtain a sample. Both farmers who had and had not established wetlands on their farms were invited to participate in the survey, which they were able to complete anonymously. A total of fifty-eight people answered the survey, of whom forty-four completed the survey. Those responses that were not complete were disregarded as there was not enough information provided in their answers to enable them to make a fair contribution to the results.

Survey data were analysed qualitatively to determine the presence or absence of relationships between possible influences and farmers' decisions towards the establishment of wetlands. Where patterns were suspected, statistical analysis was employed to determine the statistical significance of these relationships. Statistical analysis of the survey data was carried out in Minitab (Minitab Inc., 2010), initially using the Chi Square test, however, due to the small sample size it was deemed that the Fisher's Exact Test of Independence was more appropriate as it is more accurate when testing small data sets (McDonald, 2014).

Cluster analysis, using squared Euclidean distance as the similarity measure and Ward's method as the linkage strategy, was then used to examine the similarities across the forty-four respondents. The identification of similar subgroups served as a basis for more detailed scrutiny of the farmers, including how the various respondents in the survey were connected to one another (Byrne and Ragin, 2009). The distinct groups identified through the cluster analysis were analysed individually and comparisons between individuals in the groups were drawn against the remaining survey variables not included in the analysis.

3.3 Multiple case studies

Ecological restoration on farms is typically implemented at a community or individual level and therefore it was appropriate that this research provided in-depth information at a micro-scale (Wilson, 2010). Researchers are limited in the generalisations they can make from case studies, however, this method is highly valuable for providing insight on people's experiences and thought patterns (Bryman, 2001; Halperin and Heath, 2012).

Case studies in environmental-agricultural research commonly employ semi-structured interviews and can use a single case study or a multiple case study strategy (Walford, 2002; Bowen, 2009; Stuart and Gillion, 2013). For this research, multiple case studies were utilised to enable a comparative analysis to be made between contrasting cases, thus, allowing the research issue to be understood more thoroughly (Bryman, 2001). In addition, multiple case studies were considered appropriate as farming and its associated water quality issues are

not isolated to one part of New Zealand. Furthermore, it was intended that a nationwide perspective would enable the research findings to be applicable to a variety of situations.

3.3.1 Interview data collection and analysis

Prior to undertaking the case study research a survey had been conducted which invited respondents who had established wetlands on their farms to participate as a case study. These interested respondents, as well as farmers suggested by Fish and Game, and the National Wetland Trust of New Zealand, comprised a short list of twenty-one potential case study sites. Prospective participants were contacted by phone and asked a number of screening questions, from which eight cases were selected. Screening questions included the type of farm they operated; where it was located; the size of the wetland they had developed or were developing; when they had started work on their wetland; what work they had undertaken to establish their wetland (such as planting, weed control, and/or earthworks); what the main motivating factors were for carrying out the work; and whether or not they were given any assistance, including funding.

The eight case study sites selected for this research were chosen based on the fulfilment of the following criteria: proactive enhancement or establishment of a functioning wetland on a privately-owned, New Zealand farm (excluding riparian strip planting); examples across a variety of production types; a range of geographical locations throughout New Zealand (including both the North and South Islands); varied motivations for the work being undertaken; and at least some of the farmers who had received some level of funding and/or outside support. General background information about each of the eight selected case studies is in Appendix C.

In addition, three other interviews were carried out with people who had worked with farmers in developing wetlands on their properties. They were: a retired councillor from the lower half of the North Island, an employee from a non-government environmental organisation who had worked closely with farmers in the far south of the South Island, and an employee from a not-for-profit hunting organisation who works in the central North

Island. While these interviews were not part of the main analysis, they did provide useful insights on a number of issues.

Semi-structured interviewing was used during the case study research because of its effectiveness in attaining descriptive data on dynamic topics from the perspectives of participants, as well as its ability to provide cross-case comparability between multiple case studies (Bryman, 2001; Neuman, 2011; Fisher, 2012; Stuart and Gillion, 2013; Smith and Sullivan, 2014). Additionally, the utilisation of semi-structured interviews was considered appropriate due to their flexibility which encourages participants to share their knowledge in a meaningful way as the interviewing process can be adapted to match the individual's expertise and background. This approach is advantageous as it allows new issues to be raised that may not have been originally deemed as significant (Driedger *et al*., 2006; Jepsen and Rodwell, 2008). Interviewees were asked a series of general, open-ended questions, which were quite broad to begin with before becoming more specific, to avoid question order effect, where previous questions can influence the answers given to later ones (Halperin and Heath, 2012).

Questions were designed to test the theoretical framework developed in Chapter Two, as well as to identify any additional factors of influence. Interviewing was undertaken face-to-face when possible as it enables more effective probing and for supplementing observations made from body language (Halperin and Heath, 2012). Seven of the eight case studies and two of the additional interviews were conducted in-person, with the remaining case study and the last of the additional interviews carried out by phone. In-person interviews were undertaken on the farmers' properties, either at their houses, offices, or on the farm itself, and included a site visit to their wetlands. All interviews were audio recorded to facilitate effective interviewing techniques, including the retention of good eye contact and rapport with the interviewee. Additionally, audio recordings enabled accurate data collection and provided an on-going source of reference (Driedger *et al*., 2006; Jepsen and Rodwell, 2008). Following the interviews, significant and relevant information from the recordings were transferred into written notes.

For the eight case studies, the participants were asked a series of nine open-ended questions, however, due to the semi-structured nature of the interview not all interviewees were asked these questions in the same order or with the exact same wording. The outline of the interview structure is in Appendix B. Additional questions were asked if relevant new topics emerged during the interview, and at the conclusion of the interview participants were given the opportunity to ask questions themselves, as well as add any additional information that they felt had been missed. This approach allowed the interview to resemble a natural conversation and for significant issues to be followed in more depth. Probing questions and prompting were employed to extract further information from the interviewees, while repeating information back to the participant assisted in clarifying comments.

Information from the eight case studies was initially processed by systematically organising the notes under each of the nine interview questions, with additional information placed into a separate category. A three-step coding process (open, axial, and selective coding) was then applied to the data to identify patterns in the information (Neuman, 2011). Open coding grouped similar information between different interviewees into a series of themes, while axial coding provided links between these different themes. Finally, selective coding was used to organise data and codes from the axial coding into cases which were similar and dissimilar in regard to their themes, with comparisons being drawn between the different interviewees, thus, allowing the interviewees to be broadly characterised into groups. To ensure that the study remained objective, judgements for the organisation of data were made in an open, grounded, and transparent way, based on evidence and data (Bryman, 2001; Creswell, 2003; Walliman, 2006; Neuman, 2011; Tolich and Davidson, 2011).

Systematic organisation of the data was followed by qualitative analysis of the information against the theoretical framework, which assisted in improving the validity of the research and the reliability of the data (Bryman, 2001). Individual interviewees were analysed against each of the eight main factors of influence to assess the effects of these factors on

each participant. Further analysis was carried out to identify the common factors of influence between interviewees with similar motivations.

3.4 Positionality and ethics

Ethics is an unavoidable issue, especially in research dealing with people, and it is important to address it to ensure the integrity of one's research (Bryman, 2001; Neuman, 2011; Halperin and Heath, 2012). The research was preapproved by the University of Otago's ethics committee. To obtain this approval it was necessary that all participants for the survey and interviews were fully informed of the purpose of the research, as well as advised on how the information was to be used. This allowed the participants to make an informed consent, which was required in writing from all participants. In addition, participants were made aware that they could withdraw from the study at any stage without being disadvantaged or incurring a penalty. Records from the study are kept confidential and individuals are not identifiable.

For the past four years I have developed a personal connection with this research topic as a result of living on a protected wetland site, and as such my interest in water quality issues and wetland habitats has developed significantly over recent years. This invested interest created the potential for bias, however, I also come from a dairy farming family and spent many occasions in my childhood visiting my uncle's and grandparent's farm. Together these two aspects assisted in widening my perception of the issue.

Qualitative research requires a refined approach between connecting with participants while remaining unbiased (Neuman, 2011). Throughout the research process I made a continual effort to remain objective and to be self-critical by acknowledging my views and preconceived ideas, and how these may influence the research. By engaging in this approach I was able to be empathetic and perceive the issue through the eyes of the participants. Additionally, as I have an overt interest in establishing wetlands, by referring to a theoretical framework in the analysis of the data the study was able to remain transparent and unbiased, thus, enabling valid conclusions to be drawn from the research.

3.5 Conclusion

The application of a multiple case study and survey permitted the research to explore the multifaceted factors which influence farmers' decisions regarding wetland establishment in a detailed and in-depth manner. The data generated from these approaches was analysed against a theoretical framework of criteria developed in Chapter Two, therefore facilitating the investigation of similarities between this study and existing research. The following chapter summarises the findings of the research generated from these research methods.

4. Results

4.1 Introduction

This chapter presents the research results and evaluates the relative importance of the eight main factors which, according to the literature, affect farmers' decisions regarding the restoration of EF on their properties. As discussed in Chapter Two, these are:

1. Land characteristics, e.g. topography and weather.
2. Personal characteristics, e.g. age, goals and opinions.
3. Social networks, e.g. peer pressure and collaboration with organisations.
4. Knowledge, e.g. education and ecosystem awareness.
5. Technology, e.g. complexity of the environmental initiative.
6. Economics, e.g. funding and income streams.
7. Institutional and structural arrangements, e.g. government pressure and policies.
8. Farm characteristics, e.g. stock units and farm size.

Firstly, findings from the online survey are discussed, including the results from the cross-tabulation analysis and cluster analysis. Following this, findings from the case study interviews are presented, including the qualitative analysis of the significance of each main influential factor on the research participants. Finally, new insights into factors influencing farmers' establishment of wetlands are explored, and significant factors of influence on the interviewees are summarised.

4.2 Survey results

Forty-four farmers completed the online survey in full; the majority of respondents were male and fifty-one years of age or older. Respondents included twenty-nine farmers who had established wetlands on their farms and fifteen farmers who had not. Dairy farms, as well as beef and sheep farms, were the main farming types operated by the respondents. The respondents' farms were of varying sizes, however, the majority were either between 201 and 400 ha or 801 ha and over. Most farmers owned the land they worked, with nearly an even divide between those farms which had intergenerational ownership and those that did not.

4.2.1 Cross-tabulations

Analysis of the survey results was undertaken using cross-tabulations to assess whether there was a relationship between decisions about wetland development and the eight factors listed above. Where relationships were apparent, the Fisher's Exact Test of Independence was applied to the data to ascertain the statistical significance of these associations.

Land characteristics

Land characteristics describe certain enabling and constraining factors associated with the physical elements of a property, including hydrology and weather. When participants were asked if they had existing wetlands on their farms just over half of the respondents who had not established wetlands (9 out of 15) indicated that there were wetlands on their properties, while nearly all of the respondents who had established wetlands (28 out of 29) responded that there were wetlands existing on their farms prior to developing their own wetland (Table 2.0). Therefore, those farmers who had established wetlands were more likely to have wetlands existing on their farms ($p= 0.004$). It may be the presence of existing wetlands indicates that a farm is more suitable for wetland development, or perhaps the occurrence of existing wetlands assists farmers in recognising the benefits of these habitats and, thus, encourages further development of wetland areas.

Table 2.0 Whether or not farmers have established wetlands and the presence of existing wetlands on the farm

	No	Yes	All
Has not established wetlands	6	9	15
Has established wetlands	1	28	29
N	7	37	44

Fisher's Test: two sided p-values p(O>=E|O<+E): p= 0.004 (sum of small p's).
Further explanation of the Fisher's Exact Test of Independence can be found in Chapter Three in Section 3.2.1.

Although the respondents were dominated by farmers who had established wetlands (29 out of 44), the majority of farmers who had not yet established wetlands indicated that they were open to the idea of considering wetland development (10 out of 15, $p= < 0.001$, Table 2.1). Interestingly, responses from those farmers who were not considering wetland

establishment (5 out of 15) implied they were mainly held back by their belief that their land was not suitable for wetland development. In addition, there was a general trend for those farmers who had not established wetlands to use more farm area for agricultural production (51 percent or more, Table 2.2) than those who had established wetlands (51-90 percent). This may mean that wetland establishment is more likely to occur when there is a higher percentage of marginal land.

Table 2.1 Farmers considering establishing wetlands and barriers for not establishing wetlands

	Are interested	**Not interested in wetlands**	**No money to establish wetlands**	**Land is not physically suitable**	**Not considered it before**	**Other**	**All**
Not considering	0	0	1	4	0	0	5
Considering	10	0	0	0	0	0	10
N	10	0	1	4	0	0	15

Notes: Question wording: Would you consider establishing wetlands on the agricultural land that you currently own or lease? If your answer is 'No' please select as many of the following that describe your answer.
Fisher's Test: statistically significant relationship

Table 2.2 Whether or not farmers have established wetlands and the area of their farm being used productively for agriculture

	50% or less	**51-90%**	**91% or more**	**All**
Has not established wetlands	2	6	7	15
Has established wetlands	3	18	8	29
N	5	24	15	44

Fisher's Test: no statistically significant relationship

Personal characteristics

Personal characteristics relate to enabling and constraining factors such as a farmer's age, values, attitude, beliefs, and goals. The survey gave a limited representation of farmers in some age brackets, especially those farmers forty years and under (Table 3.0). However, while there was not a statistically significant relationship, the figures do suggest that as age increases so does the likelihood of farmers developing wetlands. Perhaps surprisingly,

there was no clear pattern between wetland establishment and the environmental attitude of farmers (Table 3.1), with the majority of respondents strongly agreeing that environmental choices were part of their day-to-day lives regardless of whether they had established wetlands or not (p= 0.29). Interestingly, the results show a group of eight farmers who had established wetlands but did not incorporate environmental decisions in their daily lives, thus, suggesting that they created their wetlands for reasons other than out of environmental concern. This suggests that farmers do not have to possess strong levels of environmental stewardship to establish wetlands.

Table 3.0 Whether or not farmers have established wetlands and their age

	40 years old and under	**41 years old and over**	**All**
Has not established wetlands	4	11	15
Has established wetlands	4	25	29
N	8	36	44

Fisher's Test: no statistically significant relationship

Table 3.1 Whether or not farmers have established wetlands and the importance of environmental choices in their day-to-day lives

	Not important	**Neither unimportant or important**	**Important**	**All**
Has not established wetlands	0	0	15	15
Has established wetlands	8	2	19	29
N	8	2	34	44

Fisher's Test: statistically significant relationship

The majority of respondents identified that the establishment of their wetlands was important for the improvement of water quality (23 out of 29), erosion control and flood/stormwater control (14 out of 29), beauty of the environment (24 out of 29), and leaving a legacy for future generations (25 out of 29). Whereas economics was only indicated as important by five respondents (Table 3.2). This suggests that many farmers are less inclined to establish wetlands for economic reasons, and instead they are likely to be motivated to develop wetlands on their farms by other factors. Therefore, recognising a

farmer's personal goals would be important when seeking to encourage them to create wetlands.

Table 3.2 Farmers who have established wetlands and the importance they placed on their wetlands for improvement of water quality, erosion control, flood/stormwater control, beauty of the environment, leaving a legacy for future generations, and economic advantages

	Unimportant	Neither unimportant or important	Important	All
Water quality	3	3	23	29
Erosion control	6	9	14	29
Flood/stormwater control	8	7	14	29
Beauty of the environment	1	4	24	29
Legacy for future generations	2	2	25	29
Economic advantages	12	12	5	29

Fisher's Test: no statistically significant relationship

Social networks

Social networks refer to a farmer's influence from their social sphere, including organisations, the local community, friends, and family. It appears that farmers who had established wetlands were more likely to know of others who had also developed wetlands (Table 4.0), although this was not confirmed by statistical testing. Interestingly, however, the survey results did not suggest that being in an environmental group influenced decisions to establish wetlands (Table 4.1). Table 4.2 indicates that government and community initiatives had a positive effect on a number of farmers choosing to develop wetlands ($p= 0.025$), suggesting that if farmers have more information about wetland initiatives the proportion of them establishing wetlands rises significantly.

Table 4.0 Whether or not farmers have established wetlands and their knowledge of others establishing wetlands

	No	Yes	All
Has not established wetlands	8	7	15
Has established wetlands	9	20	29
N	17	27	44

Notes: Question wording: Do you know if any of your friends, neighbours or people in your community have carried out wetland establishment on their properties?
Fisher's Test: no statistically significant relationship

Table 4.1 Whether or not farmers have established wetlands and whether they are, or have been, members of environmental groups

	No	Yes	All
Has not established wetlands	7	8	15
Has established wetlands	17	12	29
N	24	20	44

Fisher's Test: no statistically significant relationship

Table 4.2 Whether or not farmers have established wetlands and awareness of wetland initiatives

	No	Yes	All
Has not established wetlands	12	3	15
Has established wetlands	12	17	29
N	24	20	44

Notes: Question wording: Are you aware of any government or community initiatives in your local area for establishing wetlands?
Fisher's Test: statistically significant relationship

Knowledge

Knowledge refers to a farmer's understanding of wetlands and ecosystems, as well as their formal education. From Table 5.0 it appears when farmers believe wetlands benefit farm productivity then the development of wetlands is more likely, however, statistical analysis did not confirm this. Surprisingly, the majority of all respondents regarded wetlands as important for keeping ecosystems healthy (Table 5.1), therefore suggesting that while knowledge of the benefits of wetlands is potentially encouraging for the establishment of wetlands, it does not directly result in the development of wetlands on farms.

Of those who had established wetlands, over half had a bachelor or postgraduate degree, whereas only a third of those who had not established wetlands had the same level of education (Table 5.2). However, this was only an indicative trend and was not a statistically significant relationship. Table 5.3 shows that eight out fifteen respondents who had not established wetlands were not active users of their local wetlands, and only four respondents did use their local wetlands. In contrast, seventeen out of twenty-nine

respondents who had established wetlands identified that they carried out activities on their local wetlands, and only eleven participants did not use their local wetlands. While the statistics are not significant, it suggests a trend that farmers who carry out wetland activities will establish their own wetlands.

Table 5.0 Whether or not farmers have established wetlands and their attitude on the effect wetlands have on farm productivity

	Not beneficial	**Neither agree or disagree**	**Beneficial**	**All**
Has not established wetlands	3	6	6	15
Has established wetlands	7	5	17	29
N	10	11	23	44

Notes: Question wording: Wetlands are not beneficial for farm productivity.
Fisher's Test: no statistically significant relationship

Table 5.1 Whether or not farmers have established wetlands and their attitude on the effect that wetlands have on ecosystem health

	Good for ecosystem health	**Neither agree or disagree**	**Do not keep ecosystems healthy**	**All**
Has not established wetlands	11	3	1	15
Has established wetlands	26	1	2	29
N	37	4	3	44

Notes: Question wording: Wetlands are important for keeping ecosystems healthy.
Fisher's Test: no statistically significant relationship

Table 5.2 Whether or not farmers have established wetlands and their level of formal education

	Secondary school qualification	**Tertiary diploma or certificate**	**Bachelor degree or Postgraduate qualification**	**All**
Has not established wetlands	5	5	5	15
Has established wetlands	6	8	15	29
N	11	13	20	44

Fisher's Test: no statistically significant relationship

Table 5.3 Whether or not farmers have established wetlands and whether farmers carry out activities on their local wetlands

	Carries out activities on local wetlands	No wetlands in local area	Not an active user of local wetlands	All
Has not established wetlands	4	3	8	15
Has established wetlands	17	1	11	29
N	21	4	19	44

Fisher's Test: no statistically significant relationship

Technology

Technology refers to physical attributes of the wetland, including complexity of design. Wetland size can assist in understanding the complexity of a wetland project, therefore, those respondents who had established wetlands were asked to indicate the percentage of farm area that their wetland development covered. The vast majority (23 out of 29) identified that their wetland covered 5 percent or less of their total farm area (Table 6.0). It is not possible to conclude whether this is a result of farmers wanting to reduce wetland complexity or if it is due to other factors, such as the presence of marginal land.

Table 6.0 The percentage of farm covered by wetlands established by farmers compared to the size of their farm

	5% or less	6-20%	21% or more	All
50 ha and under	2	3	0	5
51-200 ha	2	1	0	3
201-400 ha	3	2	0	5
401-800 ha	6	0	0	6
801 ha and over	10	0	0	10
N	23	6	0	29

Fisher's Test: no statistically significant relationship

Economics

Economics cover factors such as income sources, financial stability of the farmer, and affordability of the wetland development. Most of the respondents, regardless of whether they had established wetlands or not, received their primary source of income from

farming (Table 7.0), owned the farms they operated (Table 7.1), worked on farms that employed one to five people (Table 7.2), and had farmed for twenty-one years or more (Table 7.3).

Table 7.0 Whether or not farmers have established wetlands and whether farming is a primary income source

	No	**Yes**	**All**
Has not established wetlands	3	12	15
Has established wetlands	6	23	29
N	9	35	44

Fisher's Test: no statistically significant relationship

Table 7.1 Whether or not farmers have established wetlands and ownership status of the farm

	Own	**Lease**	**Own part and lease part**	**All**
Has not established wetlands	13	2	0	15
Has established wetlands	21	4	4	29
N	34	6	4	44

Fisher's Test: no statistically significant relationship

Table 7.2 Whether or not farmers have established wetlands and the number of people the farm employs

	1-5	**6 or more**	**All**
Has not established wetlands	13	2	15
Has established wetlands	25	4	29
N	38	6	44

Notes: Question wording: On average through the year, how many full-time equivalent people work on the farm?
Fisher's Test: no statistically significant relationship

Table 7.3 Whether or not farmers have established wetlands and their length of time farming

	5 years or less	6-20 years	21 years or more	All
Has not established wetlands	3	4	8	15
Has established wetlands	4	8	17	29
N	7	12	25	44

Fisher's Test: no statistically significant relationship

Table 7.4 shows that those farmers on properties owned by previous generations seem more likely to establish wetlands (15 out of 29) than those with no family history with the land (5 out of 15). Although there is no statistical relationship this trend suggests that, while intergenerational farms are not a significant factor, they may assist in the development of wetlands. In addition, there was a trend for those farmers who had developed wetlands to have lived on their properties for longer time periods (Table 7.5), which could indicate that those farmers who are more established in their farming businesses are perhaps in a more financially-able situation to develop wetlands.

Table 7.4 Whether or not farmers have established wetlands and the intergenerational status of their farm

	No	Yes	All
Has not established wetlands	10	5	15
Has established wetlands	14	15	29
N	24	20	44

Notes: Question wording: Has the farm been owned by previous generations in your family (including in-laws)?
Fisher's Test: no statistically significant relationship

Table 7.5 Whether or not farmers have established wetlands and the farmer's time on their current property

	5 years or less	6-20 years	21 years or more	All
Has not established wetlands	5	7	3	15
Has established wetlands	4	13	12	29
N	9	20	15	44

Fisher's Test: no statistically significant relationship

Overwhelming, previous literature suggests that economics is the most significant influence on farmers who are considering the restoration of EF on their properties. Interestingly, most respondents did not expect a financial return from their wetland (Table 7.6) and did not place a high value on the economic advantages that their wetland could provide (Table 7.7). In addition, those five respondents who identified economic advantages of their wetlands as important also indicated beauty of the environment as important, and four out of five believed legacy for future generations was important (Table 7.8). While the statistics are not significant, the trend suggests that even those farmers who identified economics as significant, were also equally motivated by other factors. This highlights that economics was still not an overriding influence in many cases. While none of the cross-tabulations showed significant economic relationships, in several cases the frequencies do hint at an effect. Therefore, a larger sample may provide better data and more conclusive evidence on the influence of economics.

Table 7.6 Anticipated time before financial profit is expected and the importance of economic advantages from wetland work

	Unimportant	**Neither unimportant or important**	**Important**	**All**
No financial profit expected	12	9	4	25
Profit expected within 5 years or less	0	0	0	0
Profit expected within 6 years or more	0	3	1	4
N	12	12	5	29

Fisher's Test: no statistically significant relationship

Table 7.7 Farmers who have established wetlands and the importance of economic advantages

	Unimportant	**Neither unimportant or important**	**Important**	**All**
Has established wetlands	12	12	5	29

Fisher's Test: no statistically significant relationship

Table 7.8 Respondents who rated economic advantages from their wetland as important and the importance they placed on wetland establishment for improvement of water quality, erosion control, flood/stormwater control, beauty of the environment, opportunities for recreation, and leaving a legacy for future generations

	Unimportant	**Neither unimportant or important**	**Important**
Water quality	2	1	2
Erosion control	0	3	2
Flood/stormwater control	2	1	2
Beauty of the environment	0	0	5
Legacy for future generations	0	1	4
N	4	6	15

Fisher's Test: no statistically significant relationship

Institutional and structural arrangements

Institutional and structural arrangements refer to the influence of government bodies, including their policies and regulations. Table 8.0 implies that not all farmers are motivated to improve their water quality through wetlands based on legalities. While twenty-three out of twenty-nine of the respondents identified that the improvement of water quality was an important attribute of their wetland, results for compliance with the law varied. Eleven out of twenty-nine respondents deemed compliance as an unimportant aspect of their wetland, while eleven out of twenty-nine respondents valued compliance as important. This suggests there is merit in further considering farmers' individual goals for their wetland developments.

Table 8.0 Importance of the improvement of water quality from wetland work (rows) and the importance of compliance with the law from establishing wetlands (columns)

	Unimportant	**Neither unimportant or important**	**Important**	**All**
Unimportant	1	2	0	3
Neither unimportant or important	2	1	0	3
Important	8	4	11	23
N	11	7	11	29

Fisher's Test: no statistically significant relationship

Farm characteristics

Farm characteristics include factors such as the predominant agricultural use of the farm, stock units, and farm size. Previous research suggests that farmers who own larger farms are more likely to restore EF on their properties. Statistics from this study indicate that there is no significant relationship between farm size and whether farmers have established wetlands (Table 9.0). Interestingly, there is a larger proportion of farmers who have established wetlands and operate farms which are 801 ha and over (10 out of 13) versus the overall proportion of farmers who have established wetlands in the survey (29 out of 44). However, it is not possible to say if this is a real relationship and would require a larger survey sample to determine this. The relationship between farm type and wetland establishment was also analysed but did not reveal a significant relationship or any clear trends (Table 9.1). It is important to note that, on average, beef and sheep farms represent New Zealand's larger farms, at an average size of around 700 ha. While New Zealand dairy farms have an average size of around 200 ha (Land Information New Zealand Toitu te whenua, 2012).

Table 9.0 Whether or not farmers have established wetlands and the size of their farm

	50 ha and under	**51-200 ha**	**201-400 ha**	**401-800 ha**	**801 ha and over**	**All**
Has not established wetlands	2	3	6	1	3	15
Has established wetlands	5	3	5	6	10	29
N	7	6	11	7	13	44

Fisher's Test: no statistically significant relationship

Table 9.1 Whether or not farmers have established wetlands and the type of farm they operate

	Dairy	Beef	Sheep	Beef and sheep	Deer	Arable	Other	All
Has not established wetlands	5	0	3	3	2	0	2	15
Has established wetlands	10	2	0	13	0	1	3	29
N	15	2	3	16	2	1	5	44

Fisher's Test: no statistically significant relationship

Summary for cross-tabulations

Analysis of the survey results showed that there were four statistically significant relationships. These relationships were between:

- the presence of existing wetlands on farms and the establishment of wetlands;
- farmers who had not established wetlands and willingness to create wetlands;
- the importance of environmental choices in a farmer's daily life and its lack of influence on wetland development, and;
- awareness of government and community initiatives, and wetland establishment (Table 10.0).

Although, the following trends were not statistically significant, at times the frequencies pointed to a possible link between:

- farmers who had established wetlands and were older;
- farmers who had established wetlands and had motivations other than economics for developing their wetlands;
- farmers who had established wetlands and knew of others who had created wetlands;
- farmers who had established wetlands and recognised the benefits of wetlands for farm productivity;
- farmers who had established wetlands and had higher levels of formal education;
- farmers who had established wetlands and were active users of local wetlands;
- farmers who had established wetlands and owned intergenerational farms;

- farmers who had established wetlands and had lived for longer time periods on their properties, and;
- farmers who had not established wetlands and the operation of farms with higher percentages of agriculturally productive land (Table 10.0).

Table 10.0 Summary of statistical relationships and possible important trends in cross-tabulations

SUMMARY TABLE		
	Established/establishing wetland	**Not established wetland**
STATISTICALLY SIGNIFICANT RELATIONSHIPS		
Existing wetland on farm	Yes	No
Considering wetland establishment	N/A	Yes
Environmental choices	Part of their day-to-day lives	Part of their day-to-day lives
Aware of local initiatives	Yes	No
POSSIBLE IMPORTANT TRENDS		
Productive farm area	51-90%	51% or more
Age	As age increases wetland establishment becomes more likely	As age decreases inclination to establish wetlands becomes less likely
Wetland aspects of high importance	Water quality Erosion control Flood/stormwater control Beauty of the environment Recreation Legacy for future generations	N/A N/A N/A N/A N/A N/A
Wetland aspects of lower to no importance	Economic advantages	N/A
Financial profit	Most do not expect a financial return	N/A
People in their social network have created wetlands	Yes	Either yes or no
Views on wetland benefits	Beneficial for farm productivity	No view on benefits for farm productivity
Formal education	Higher (Bachelor degree)	Lower (Secondary school qualification or tertiary diploma/certificate)
Active user of local wetlands	Yes	No
Intergenerational farm	Either yes or no	No
Majority of life in current area	Yes	Either yes or no

4.2.2 Cluster analysis

Cluster analysis was used to explore the similarities between the forty-four survey respondents, and thus examine any connections they shared. The cluster analysis used descriptor variables and the groups identified were then compared using the attitudinal variables. The descriptor variables showed that there was no clear distinction between

those farmers who had and had not developed wetlands. Descriptor variables included whether the farmer was an active user of local wetlands, were a member of an environmental group, were aware of others who had created wetlands, the type of farm they operated, the size of the farm they operated, the agriculturally productive area of their farm, whether the farm was intergenerational, the age of the farmer, the farmer's level of formal education, whether the farmer had lived the majority of their life in the area they currently farmed, and the number of years they had spent farming.

The analysis suggested five distinct groups based on the descriptor variables (Figure 3.0), each of which comprised farmers who both had and had not established wetlands. Table 11.0 outlines the characteristics of each of these groups. Cluster One represented farmers who had varied levels of formal education, were members of environmental groups, did not use their local wetlands, operated various farm types, worked farms that were 201 ha and over, operated intergenerational farms, and had spent six to twenty years farming. Cluster Two was comprised of farmers who were younger (forty years and under), had varied levels of formal education, who both did and did not know of others who had created wetlands, operated dairy farms of various sizes, had spent five years or less farming, and who both had and had not lived the majority of their lives in the area they currently farmed. Cluster Three contained farmers who were not members of an environmental group, operated beef and/or sheep farms which were 401 ha and over, and who both did and did not operate intergenerational farms. Cluster Four was characterised by farmers who had secondary school qualifications, did not know of others who had created wetlands, operated dairy farms which were 400 ha and less, and operated farms which used 91 percent or more of their land for agricultural production. Finally, Cluster Five represented farmers who operated farms which were 200 ha and less, with varied percentages of agriculturally productive land, and had not lived most of their lives in the areas they currently farmed.

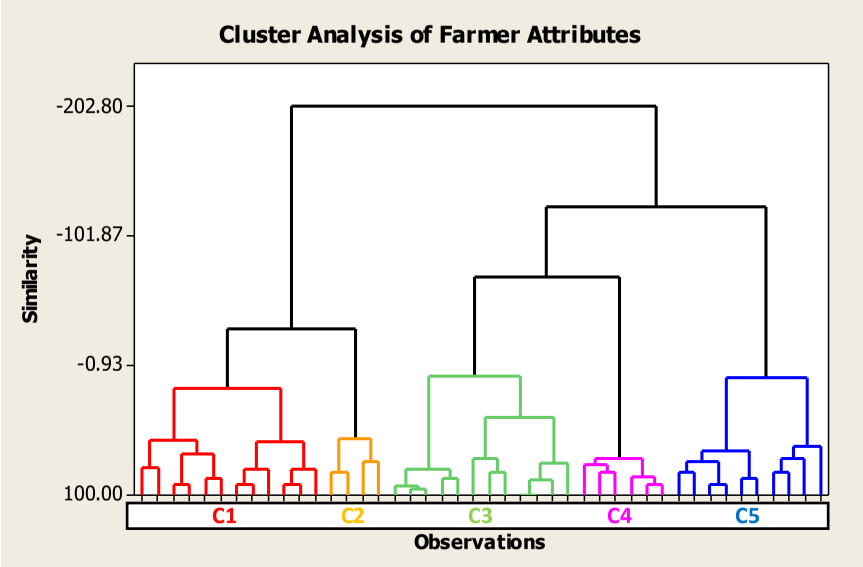


Figure 3.0 Dendrogram depicting cluster analysis (Cluster One to Five are indicated by C1 – C5)

Table 11.0 Descriptor variables for cluster analysis

Cluster	Age	Education	Member of an environmental group	Know of others who have created wetlands	Use local wetlands	Farm type	Farm size	Productive area of farm	Intergener-ational farm	Years spent farming	Lived most of their life in their current area
1	Older	Varied	Yes	Yes	No	Other	201ha+	51-90%	Yes	6-20	Yes
2	Younger	Varied	Mix	Mix	Mix	Dairy	Mix	51% or more	No	5 or less	Mix
3	Older	Bachelor+	No	Yes	Yes	Beef /sheep	401ha+	51-90%	Mix	21+	Yes
4	Older	Secondary	Mix	No	Yes	Dairy	400ha & less	91% or more	No	21+	Yes
5	Older	Bachelor+	Mix	Yes	Mix	Beef/ sheep or other	200ha & less	Mix	No	21+	No

There did not appear to be a clear distinction between those farmers who had and had not established wetlands and their attitudes, with most farmers appearing to have positive environmental attitudes regardless of whether they had established a wetland or not (Table 11.1). Attitudinal variables included farmers' opinions on the importance of conservation as part of their land management aims and the importance of making environmentally-conscious choices in their daily lives, as well as whether farmers believed wetlands are beneficial for farm productivity and are important for keeping ecosystems healthy.

The attitudinal question on the benefit of wetlands for farms was the only attitudinal variable that had a significantly statistical relationship with a cluster (highlighted in Table 11.1). The analysis showed a statistical relationship between this attitudinal variable and Cluster Two's respondents, who regarded wetlands as not being beneficial for farm productivity ($p= 0.028$, highlighted in Table 11.2). However, as Cluster Two represents an even mixture of farmers who had and had not established wetlands it implies that there is not a distinctive link between a farmer's environmental attitude and wetland development. Additionally, Cluster Two appears to be unique as it represents farmers who place varying levels of importance on incorporating conservation into their land management aims (highlighted in Table 11.1), unlike the other clusters which regard this as important, however, this pattern was not confirmed by statistical testing.

Table 11.1 Attitudinal variables for cluster analysis
(Cluster Two's unique attributes are highlighted in orange)

Cluster	Conservation is part of land management aims	Environmental choices part of daily life	Believe that wetlands are beneficial for farm productivity	Believe that wetlands are beneficial for the health of ecosystems
1	Yes	Yes	Mixed	Yes
2	Mixed	Yes	Yes	Yes
3	Yes	Yes	Yes	Yes
4	Yes	Yes	Yes	Yes
5	Yes	Yes	Mixed	Yes

Table 11.2 Cluster analysis results depicting the relationship between attitudes on the benefits of wetlands for farm productivity (statistically significant relationship for Cluster Two is highlighted in orange)

Cluster	N	Median	Avg Rank
1	12	2	26.8
2	4	1	12.0
3	12	1	17.1
4	6	2.5	31.4
5	10	1.5	22.6
Overall	44		22.5

Notes: Question wording: Wetlands are not beneficial for farm productivity. Codes: 1 = Disagree, 2 = Neither agree or disagree, and 3 = Agree

Overall, results from the cluster analysis suggest that there were no overriding attributes which distinguish those farmers who had and had not established wetlands on their properties, therefore, implying that there are numerous factors influencing farmers' decisions around EF restoration. However, analysis from Cluster Two, which was characterised by younger farmers who had farmed for five years or less and did not necessarily regard conservation as important in their land management aims, could imply that younger farmers are less established and therefore are not in financial situations which would allow for the development of wetlands on their farms.

4.2.3 Summary of survey findings

The survey results largely support what the research literature suggests as the eight major factors of influence. Those specific factors which appear to assist in enabling the development of wetlands include the presence of existing wetlands on farms, awareness of local initiatives, farms with lower percentages of agriculturally productive land, and farmers who are older, know of others who have developed wetlands, understand the benefits of wetlands for farm productivity, have higher levels of formal education, are active users of their local wetlands, operate intergenerational farms, and who have lived the majority of their lives in the areas they currently farm. Interestingly, in contrast to previous research, it was found that economics was not largely influential on the establishment of wetlands, nor were environmental attitudes. However, the survey is not representative of all farmers and therefore these conclusions are about the set of farmers who completed the survey, who are likely to be biased towards wetlands as those with

little real interest in wetlands are unlikely to have responded to the survey. Even so, it is apparent that the development of wetlands on farms is a complex issue and there are multiple factors which intersect in various ways to influence farmers' decisions.

4.3 Interview results

Eight farmers who had established wetlands, or were in the process of developing their wetland, were interviewed from various locations around the North and South Islands of New Zealand. All of the interviewees were male, the majority being over forty-one years of age when they started their wetland work, and operated farms which were between 200 and 500 ha. The farmers were varied in the types of farms they operated, the length of time they had lived on their properties, and the size of the wetlands they had established (Table 12.0). Throughout the remainder of this chapter these farmers are referred to as F1 to F8. In addition, three other people were interviewed who through their employment have had extensive involvement with farmers developing wetlands. They were: an ex-councillor, a staff member from a non-government environmental organisation, and an employee from a not-for-profit hunting organisation. These key informants are referred to as KI1, KI2, and KI3. Interview data were analysed to ascertain the presence or absence of the eight factors of influence, as identified from the research literature. During the interview process it became apparent that influences and motivations often change during the development of wetlands and it is a continual process, therefore, analysis was based on both the establishment and ongoing development of the wetlands. Overall, it was found that no two farmers were the same across all the factors.

Table 12.0 General characteristics of the farmers interviewed

Farmer	Age when started wetland	Highest formal qualification	Farm type	Farm size (ha)	Location (North or South Island)	Intergene-rational farm	Years lived on current property	Wetland size (ha)
F1	41 and over	Bachelor degree	Dairy	325	North	No	12	0.75
F2	41 and over	Secondary school	Dairy	90	North	No	36	16
F3	40 and under	Secondary school	Sheep and dairy grazing	276	South	Yes	Since childhood	20
F4	40 and under	Secondary school	Sheep and beef	1430	South	No	11	6.7
F5	40 and under	Bachelor degree	Beef	235	North	Yes	Since childhood	7
F6	41 and over	Bachelor degree	Beef	40	South	No	10	Not started
F7	41 and over	Secondary school	Sheep, dairy grazing and beef	224	South	No	11	20
F8	41 and over	Bachelor degree	Sheep, beef and deer	456	North	Yes	Since childhood	4.4

4.3.1 Enabling and constraining factors

Information gathered from the eight farmers was analysed using a three-step coding process to identify patterns in the findings, which were then examined against the theoretical framework developed in Chapter Two. The elements of influence identified for the individual farmers were evaluated to determine the overall impact that each of the main eight factors of influence seemed to have had on the interviewees. In the following section two tables are presented for each factor. The first table shows the specific characteristics of influence under each factor and whether they applied to each of the farmers interviewed (indicated by a coloured cell when applicable). The second table presents the overall evaluation of the nature of the influence, whether it has supported wetland development, or constrained it, for each of the farmers interviewed.

Land characteristics

When interviewing the farmers it quickly became apparent that land characteristics had a significant influence on their decisions regarding their wetland developments. Crucially all the farmers owned farms that had wet zones and areas with low productivity (Table

13.0). For instance, half of the farmers (F3, F4, F7, and F8) explicitly stated they did not feel that the establishment of their wetlands would result in a loss of productive agricultural land as the intended sections for wetland establishment were very wet. In addition, F7 was motivated to develop their wetland to provide shelter for their stock from the high winds that occur on their property.

Table 13.0 Significant factors of influence on each farmer for land characteristics

	F1	F2	F3	F4	F5	F6	F7	F8
LAND CHARACTERISTICS								
Wetland was present on their farm already			■		■		■	
Have naturally wet areas on their farm	■	■	■	■	■	■	■	■
Areas of the farm become waterlogged during parts of the year	■	■	■		■			
Have areas on their farm with low agricultural productivity	■	■	■	■	■	■	■	■
The farm has peat soils	■	■						
The farm has clay soils					■			
Gullies are predominant on their farm				■			■	■
Wind is influential on their farm	■						■	■
Farm is sited in the upper reaches of the catchment				■				■
Farm is sited in the middle to lower reaches of the catchment	■	■	■		■	■	■	
The land was relatively undeveloped when they purchased it							■	

The research literature shows that soil conditions can influence farmers' decisions to restore EF and this was an aspect which was mentioned be a number of farmers (F1, F2, and F5) in this study. Two of the farmers (F1 and F2) operated farms with peat soils, which require moisture to prevent peat shrinkage and consequent subsidence of land and, therefore, benefit from the presence of wetlands. F5's property was characterised by clay soils which resulted in areas of their farm becoming extremely wet during parts of the year.

In order for wetland development to occur it is apparent that the land needs to be suitable for wetlands. Farms that have areas of low agricultural productivity are also significantly enabling, while other land characteristics such as impermeable soils are likely to improve the adoption of wetland establishment, however, these elements are not essential.

Therefore, as illustrated in Table 13.1, the farmers' land characteristics were deemed as enabling for all participants in the development of their wetlands.

Table 13.1 Overall influence of land characteristics for each farmer

FACTOR: Land characteristics			
Interviewee	**Constraining**	**Neutral**	**Enabling**
F1			
F2			
F3			
F4			
F5			
F6			
F7			
F8			

Personal characteristics

Important attributes which contributed to making personal characteristics enabling were that the wetlands were in line with farmers' personal goals and the farmers possessed high motivation levels for their wetland projects. F2, who was extremely driven to undertake their wetland project, stated: *"you've got to have a driver, if you haven't got a driver you're in trouble."*

When asked about their motivations for establishing their wetland two farmers (F2 and F5) mentioned experiencing the effects of wetland loss on their parents' farms in their respective childhoods. Their responses demonstrated a strong sensitivity to land degradation from this experience (Table 13.2). For example, F2 was motivated to develop their wetland to protect the lakes adjacent to their property from disappearing as a result of sedimentation, which they had seen happen to other lakes in the area: *"could you sit here and watch these lakes disappear? No. That's why* [they undertook their wetland work]."

Table 13.2 Significant factors of influence on each farmer for personal characteristics

	F1	F2	F3	F4	F5	F6	F7	F8
PERSONAL CHARACTERISTICS								
41 years of age and over when they started their wetland	■	■				■	■	■
40 years of age and under when they started their wetland			■	■	■			
Wetland was in line with their personal goals	■	■	■	■	■	■	■	■
Highly motivated	■	■	■		■	■		
Interested in providing some environmental benefit via their wetland development	■	■	■	■	■	■	■	■
Strongly motivated to provide environmental benefits		■			■			
Equally motivated by environmental and business benefits						■		
Strongly motivated by business benefits	■							■
Strongly motivated by personal and/or recreational benefits			■				■	
Strongly motivated by an equal mixture of personal, recreational, and business benefits				■				
Strong sensitivity to land degradation	■	■			■	■		
Capable of change	■	■	■	■	■	■	■	■
Displayed a resilience to risk	■	■			■	■		

Previous research suggests that younger farmers are more likely to restore EF on their farms than their older counterparts. Intriguingly, results from the interviews indicate that age had a minimal influence, with time spent developing the farming business having had more of an effect on the farmers. When F1 was questioned about how influential economics had been on the development of their wetlands, they said that they had been able to undertake more environmental work, including the establishment of their wetland, as they had grown older because they had also become more financially secure with time. This was supported by a younger farmer (F4) who was still developing their farm and consequently felt that they would not have been able to establish their wetland without the aid of external funding. F8 was looking to retire and had found that as their interest in developing their farm had now lessened, their motivation to continue with their wetland project had also decreased. KI1 and KI3 emphasised that young farmers are newer to the industry and have the pressure of big mortgages.

Interestingly, while the research literature primarily refers to the motivations and attitudes of farmers at the initial establishment stage of a wetland project, when participants in this study were asked what motivated them to undertake their wetland work it was clear that while farmers were initially focused on developing their wetland for specific reasons; as their projects developed so did their motivations for the work. For instance, when F3 was asked to identify their motivations for establishing their wetland they mentioned that their original reason was to create an area for ducking shooting. However, once this aim was achieved, they shifted their focus onto improving water quality and altered their wetland design accordingly. F8 believed their environmental thinking was something that had developed as they had become more involved in ecological initiatives. Similarly, KI1 mentioned projects that they were aware of where farmers had been initially motivated to create wetlands out of compliance but as they progressed with their projects they began to see the full potential of their wetlands and had, therefore, continued to expand on their development beyond their initial reasons. Overall, based on the above influences, it was concluded that for most of the farmers (F1, F2, F3, F5, and F6) personal characteristics were an enabling factor (Table 13.3).

Table 13.3 Overall influence of personal characteristics for each farmer

FACTOR: Personal characteristics			
Interviewee	**Constraining**	**Neutral**	**Enabling**
F1			
F2			
F3			
F4			
F5			
F6			
F7			
F8			

Social networks

This is one of the more complex of the eight main factors as different individuals or groups in a farmer's social network may have varying degrees of influence on that farmer. The main aspects which comprise a farmer's social network include their community, organisations, their closer social circle (including friends and personal acquaintances), and family.

When participants were asked to identify people they had felt influenced by during their wetland development all but one farmer (F2) mentioned that they felt pressure from the non-farming community to undertake environmental work. Although none of them were motivated to carry out their wetland work in response to this pressure, it had resulted in some farmers (F8 and F3) undertaking water monitoring. F3 referred to the need for water monitoring by saying that "*unless we get a handle on what we're doing, we won't be able to farm because sooner or later some green person is going to say, you need a consent to farm. Now that's going to be a nightmare because somebody else is going to decide what you and can't do on your farm.*" Interestingly, while the literature suggests that community pressure can encourage the establishment of wetlands, F5 said community pressure was not always feasible in small communities as people do not want to damage close-knit relationships.

All of the participants received support from organisations for their wetland projects (Table 13.4), with some participants experiencing both enabling and constraining effects from organisations (F2, F6, and F7). For example, F7 described the good relationship they had built with their district council during the establishment of their wetland; however, in contrast, they felt that an individual from another organisation hindered their project as this person was not prepared to work with them. There was broad agreement among the farmers that trust, long-term relationships, the provision of practical knowledge, being prepared to work with farmers, and sharing the same values were all important when collaborating with farmers. High staff turnover and compliance matters were specifically mentioned as being detrimental to building trusting relationships with environmental advocates. Supporting this, KI3's experience was that high staff turnover rates in agencies was discouraging and disruptive for farmers, with trust having to be rebuilt each time with the new representative.

Table 13.4 Significant factors of influence on each farmer for their social networks

	F1	F2	F3	F4	F5	F6	F7	F8
SOCIAL NETWORKS								
Were influenced by their family		■	■	■	■			■
Intend to pass their farm on to their children		■	■					
Did not experience peer pressure to carry out their wetland work	■	■	■	■	■	■	■	■
Experienced peer pressure not to carry out their wetland work		■		■	■		■	
Constrained by neighbour(s) not sharing the same environmental values	■	■			■		■	
Had access to information from their social circle	■	■	■	■		■	■	
Other farmers have been a valuable source of information			■			■		
Close proximity to others who had created wetlands			■				■	
Did not know of others who had created wetlands				■	■			
Had community support	■	■	■	■	■	■		
Felt community pressure to undertake environmental work	■		■	■	■	■	■	■
Received support from organisations	■	■	■	■	■	■	■	■
Received good support from organisations	■			■				
Received a moderate amount of support from organisations		■	■		■	■	■	■
Experienced a lack of support from organisations		■				■	■	
Receive good ongoing support	■							
Receive moderate ongoing support		■	■	■	■	■	■	
Do not receive ongoing support								■
Member of a farming and/or environmental group	■		■		■	■		■
Involved in a land-care group	■		■		■	■		
Have made an effort to share the information they have learnt during their wetland project	■	■	■	■	■	■		
Intergenerational farm (2-6 generations)			■		■			■
Non-intergenerational farm	■	■		■		■	■	

Previous studies suggest that a farmer's peers can influence their decision to restore EF on their property. Surprisingly, in this study while half of the participants (F2, F4, F5, and F7) felt peer pressure from other farmers and their neighbours against their wetland projects (Table 13.4), they were not deterred from establishing their wetlands. For example, F3 was approached by other farmers saying "*your father spent 30 years draining it* [the farm] *and here*

you are putting it back," yet they had created one of the largest wetlands out of all of the participants. Ironically, while none of the farmers believed they were influenced by peer pressure, some of the interviewees had successfully influenced other farmers to establish wetlands. In KI2's experience the most positive stimulus for encouraging wetland development came from other farmers. This suggests that positive peer pressure has the capacity to be enabling but negative peer pressure is not necessarily constraining.

The majority of the farmers (F2, F3, F4, F5, and F8) stated that their wetland developments were influenced by their families, however, the nature of that effect varied (Table 13.4). Two farmers (F2 and F5) found their families to be extremely supportive of their wetland projects and F5 specifically mentioned that they felt they had inherited their care for the land as a result of the long family holding of the property (they were the fifth generation to inherit the farm). In contrast, F3 was not influenced by their father, who held different environmental values to them. However, F3's son, who also did no regard wetlands in the same manner as them, was influential in deterring F3 from establishing a wetland elsewhere on their farm. Different family members, it seems, can be more influential than others on farmers' decisions regarding the development of wetlands.

Results from the research show that farmers' social networks were important for providing knowledge on wetland establishment. Almost all of the farmers (F1, F2, F3, F4, F6, and F7) mentioned that they had received information on wetlands from people in their social circle (Table 13.4). F1 specifically mentioned that one of the main enabling factors for their wetland development was being able to draw on a wealth of information from the various backgrounds of the syndicates who jointly owned the farm with them. Likewise, one of the main enabling factors for F2 was that they were able to access valuable knowledge from their son on information about the practicalities of implementing wetlands.

The findings show that there was some variance in the influence of social networks on the participants, with half of the farmers (F1, F3, F4, and F8) experiencing a supportive influence from their social networks, while the other half (F2, F5, F6, and F7) were neither enabled nor constrained by this factor (Table 13.5).

Table 13.5 Overall influence of social networks for each farmer

FACTOR: Social networks			
Interviewee	**Constraining**	**Neutral**	**Enabling**
F1			
F2			
F3			
F4			
F5			
F6			
F7			
F8			

Knowledge

On the weight of evidence from the interviews it would appear that knowledge was constraining for a couple of farmers (F3 and F8). Although the farmers did not explicitly refer to knowledge as constraining, overall their situation would suggest that it was. For instance, while these farmers (F3 and F8) were comfortable learning via personal trial and error when creating their wetlands (Table 13.6), this approach hindered the progress of successfully establishing their wetlands. Similarly, while two other farmers (F4 and F7) lacked personal knowledge on wetland development, they felt that this was not a barrier as they were able to access information from their social networks. When participants were asked about sourcing information for their wetland projects, some of the farmers (F1 and F6) identified that access to information was not always easy and suggested the effort of locating information could be improved by sharing knowledge in a format which was targeted at farmers. Similarly, KI1 and KI3 believed that organisations needed to collaborate and cross-fertilise ideas to make it easier for farmers to receive coherent information.

Table 13.6 Significant factors of influence on each farmer for knowledge

	F1	F2	F3	F4	F5	F6	F7	F8
KNOWLEDGE								
Aware of the on-farm benefits of wetlands	■	■	■	■	■	■	■	■
Well-aware of the linkages between their farm and the surrounding environment	■	■	■	■	■	■	■	■
Well-developed ecological awareness	■	■			■			
Strong background in conservation	■	■			■			
Have undertaken previous environmental work	■	■			■			■
Formally educated in environmental management and wetland development/restoration					■			
Exposed to wetlands prior to creating their wetland	■	■	■	■	■	■	■	■
High level of exposure to wetlands prior to creating their wetland	■	■			■			
Highly influenced by other wetlands		■	■					
Knowledge on wetlands was derived partially from personal observations		■						
Personal learning through trial and error	■	■	■					■
There were not many others creating wetlands (or their style of wetland) when they established their wetland	■		■					■
Experienced a lack of practical and/or correct information	■	■	■					■
Had access to plenty of information				■			■	
Bachelor degree	■				■	■		■
Secondary school qualification		■	■	■			■	

From the interviews it was clear that a few of the participants (F1, F2, and F5) had a well-developed knowledge of ecology and wetlands prior to the establishment of their own wetland, and this was attributed to: previous involvement in environmental activities, prior exposure to wetlands, formal education and training courses, or information from family members (Table 13.6). Additionally, a number of farmers (F1, F2, F3, F5, and F8) felt that since establishing their wetland their ecological awareness had increased. When asked whether they had experienced an increase in knowledge since creating their wetland F1 said "*yeah, a thousand times over*." This implies that participation in, and exposure to, environmental initiatives has the potential to encourage farmers to establish wetlands.

Surprisingly, half of the farmers (F2, F3, F4, and F7) only had secondary school qualifications at most, suggesting, contrary to the majority of the literature, that formal

education was not a significant influence (Table 13.6). In general, previous research stresses the importance of knowledge for the implementation of EF restoration. However, some of the farmers in this study (F2, F6, and F7) felt that ongoing information on the success of an implemented wetland, such as through water monitoring, was equally important. These participants agreed that if farmers were aware of the quality of their water from ongoing testing they would be more likely to take ownership of their actions and be more inclined to establish wetlands. Overall, the farmers exhibited varying levels of knowledge and, therefore, there was variation on how constraining or enabling this factor was on the participants (Table 13.7).

Table 13.7 Overall influence of knowledge for each farmer

FACTOR: Knowledge			
Interviewee	**Constraining**	**Neutral**	**Enabling**
F1			
F2			
F3			
F4			
F5			
F6			
F7			
F8			

Technology

Those aspects which made technology constraining for some farmers (F2 and F3) were the complexity of their wetland, its large size, the high levels of effort that were required to establish their wetland, and the amount of ongoing maintenance it required (Table 13.8). A number of farmers (F1, F2, F4, F5, and F8) cited the ongoing maintenance of wetlands as being, or potentially becoming, a barrier. Likewise, KI3 believed that wetlands which required high ongoing maintenance could fail because maintenance often came low on a farmer's priority list. It is interesting to note that the research literature makes little mention of the importance of considering the ongoing maintenance of EF restoration projects.

Table 13.8 Significant factors of influence on each farmer for technology

	F1	F2	F3	F4	F5	F6	F7	F8
TECHNOLOGY								
Involved in the development of their wetland	■	■	■	■	■	■	■	■
Complex wetland design	■							
Semi-complex wetland design		■	■		■			
Simple wetland design				■		■	■	■
Large wetland (16-20 ha)		■	■				■	
Medium sized wetland (4.4-7 ha)				■	■			■
Small wetland (<1 ha)	■					■		
High levels of effort required to establish their wetland	■	■	■					
Mid-levels of effort required to establish their wetland				■	■			
Lower levels of effort required to establish their wetland						■	■	■
Wetland improved the economic efficiency of their farm management	■							
High levels of ongoing maintenance	■	■						
Mid-levels of ongoing maintenance			■		■			
Low levels of ongoing maintenance				■		■	■	■
Experienced instant results from their wetland	■							

When participants were asked what enabled them to undertake their wetland projects, some farmers (F4 and F6) specifically mentioned ease of implementation as assisting in the establishment of their wetland. Two farmers (F2 and F4) emphasised the ability of native plants to self-regenerate as enabling their projects, while F6 was planning their wetland to be small and straightforward to implement using on-farm equipment. Additionally, for F4 a main enabling factor was the ease and quickness of constructing their wetland. This was reiterated by KI3 whose experience was that if a wetland project kept progressing quickly it helped maintain enthusiasm for the project. In all, as shown in Table 13.9, the influence of technology was mixed among the farmers; however, for half the participants (F4, F6, F7, and F8) it was an enabling factor.

Table 13.9 Overall influence of technology for each farmer

FACTOR: Technology			
Interviewee	**Constraining**	**Neutral**	**Enabling**
F1			
F2			
F3			
F4			
F5			
F6			
F7			
F8			

Economics

Three farmers (F3, F5, and F7), when asked about the influence of finances on their wetland projects, explicitly stated that they were constrained by availability of money (Table 13.10) but despite this they were not opposed to developing their wetlands in stages as finances allowed. This suggests that while economics were still constraining for these farmers the potential barrier of this factor could be overcome by other influences.

All of the farmers received some funding to help their wetland projects, although the amount varied substantially (ranging between NZ $1,000 and $111,000, Table 13.10). This difference partially reflected farmer attitudes. For example, two farmers (F3 and F7) preferred not to receive grants. For F3 this was because they felt that accepting the grants could result in losing control over their property, while F7 did not share the same values as the funding agency and experienced a personality clash with the funding advocate. F4 deemed funding to be necessary for the establishment of their wetland and was granted NZ $15,000, covering 50 percent of the project costs, indicating that they were still willing to spend a significant amount of their own money on their wetland (Table 13.10). This implies that the influence of economics is partly dependent on a farmer's desired end outcome for their wetland, with more ambitious projects possibly running a higher risk of encountering economic barriers.

Table 13.10 Significant factors of influence on each farmer for economics

	F1	F2	F3	F4	F5	F6	F7	F8
ECONOMICS								
Recognised the monetary benefits of wetlands	■	■	■	■	■	■	■	■
Own the farm they operate	■	■	■	■	■	■	■	■
Lease additional paddocks	■				■			
Wetland developed on predominately agriculturally unproductive land	■	■	■	■	■	■	■	■
Money was a driving factor	■					■		
Money was not a driving factor		■	■	■			■	■
Money was not important					■			
Expect a financial return from their wetland	■						■	■
Do not expect a financial return from their wetland					■			
Wetland provided them with an economic gain		■	■	■	■		■	■
Wetland was more economically efficient than existing farm management practices	■							
Diverse income stream	■				■			■
Singular income stream		■	■	■		■	■	
Had the money available to do the work	■	■						■
Wetland was constrained by availability of money			■	■	■	■	■	
Funding was not necessary but helpful	■	■			■			■
Funding was necessary				■		■		
Would rather not receive funding			■				■	
Received a vast amount of funding	■							
Received substantial funding				■	■			
Received a moderate amount of funding		■				■		■
Received minimal funding			■				■	
High land value	■	■						
High costs to establish wetland	■							
Mid-range costs to establish wetland		■	■	■			■	
Low costs to establish wetland					■	■		■
Lived on their farm for a relatively short period (10-12 years)	■			■		■	■	
Lived on their farm for a substantial time (36 years)		■						
Lived on their farm since childhood			■		■			■
Had time available to establish their wetland	■	■						■
Constrained by lack of time available to establish their wetland					■	■		
Constrained by lack of time to continue establishing their wetland					■			■

For a large number of participants (F2, F3, F4, F7, and F8), economic returns from their wetland was identified as assisting in the development of their wetland, although it was not necessarily an overriding factor. F8 believed that their increased stock safety as a result of setting aside wet farm areas for fenced wetland development would easily counter-balance the money they had spent on constructing their wetland and "*financially it made sense*." For F3, due to the current low economic return of sheep farming, it was not financially efficient for them to drain the wet areas on their farm and this directly contributed to the extensive establishment of wetlands on their property.

Findings from this study support the prevailing view in the literature that off-farm incomes assist in EF restoration. However, in addition, this research found that diversification of on-farm income was also beneficial. Furthermore, previous research does not emphasise the availability of time as a facilitating aspect of economics. However, a number of farmers in this study (F1, F2, and F8) mentioned availability of time as a major aiding factor, while lack of time was identified as a constraining, or potentially constraining, factor by others (F5 and F6). This suggests the importance of understanding the long-term time requirements of establishing wetlands.

The mainstream thinking in the research literature identifies economics as the most significant factor influencing farmers making decisions about restoring EF. Economics was a constraining factor for the majority of the participants in this study (F3, F4, F5, F6, and F7), however, for a few farmers (F1, F2, and F8) it facilitated their wetland developments (Table 13.11).

Table 13.11 Overall influence of economics for each farmer

FACTOR: Economics			
Interviewee	**Constraining**	**Neutral**	**Enabling**
F1			
F2			
F3			
F4			
F5			
F6			
F7			
F8			

Institutional and structural arrangements

Institutional and structural arrangements were identified as a constraining factor for two farmers (F2 and F6). These farmers felt that these were a barrier due to a lack of coherency and knowledge from government organisations (Table 13.12). Although all of the farmers identified resource consents as constraining, or as having the potential to become constraining, on the establishment of their wetlands, none of them were actually required to apply for consents. F4 described avoiding the need for resource consent, due to its extensive costs, as the biggest barrier to their wetland project, yet in the end they did not need to alter the design of their wetland to achieve this. However, some of the wetland projects advocated by F6 in their catchment, were abandoned as they required resource consent, which made the wetlands too complicated and costly to be feasible. F6 said: "*as soon as you mention consent people put it in the bottom drawer*." KI2 and KI3 also believed that the time and money involved in the resource consent process was constraining and had heard, or knew, of farmers forsaking projects in response. KI3 also explained that the lengthy legal process of obtaining a resource consent slowed down the implementation of wetlands and they found that when there was a big delay before starting a project, it could reduce the farmer's initial impetus for the work.

When participants were asked what they thought would have made the process of creating their wetlands easier, a number of farmers (F2, F5, F6, and F7) believed that improvement in the practicality of resource consent procedures would be beneficial. KI1 and KI3 built on this, and felt that regulators lacked pragmatic knowledge about farming and especially wetland establishment. Additionally, some farmers (F2, F5, and F6) were frustrated that councils did not enforce their own regulations and felt people were able to get away with damaging the environment, "*I don't care what anyone else says, I think the real issue is that regional council isn't enforcing their rules and policies*" (F5).

Table 13.12 Significant factors of influence on each farmer for institutional and structural arrangements

	F1	F2	F3	F4	F5	F6	F7	F8
INSTITUTIONAL AND STRUCTURAL ARRANGEMENTS								
Did not need to apply for resource consent								
Viewed resource consent as a potential major barrier if it had been required								
Wetland work constrained by regulations								
Some future wetland work will be policy driven								
Policies were not highly influential because there were less regulations when they created their wetland (17-40 years ago)								
Their strong environmental stewardship (rather than the influence of policies) meant they were not concerned that their wetland benefited their neighbours								
Their environmental stewardship combined with the influence of policies meant they were not concerned that their wetland benefited their neighbours								
Government pressure added to the drive of their wetland work								
Experienced a lack of knowledge from the government								
Experienced a lack of coherency from the government								

Participants suggested a number of specific aspects which they felt would improve regulations. They included: reducing the required paperwork, to be objective focused rather than overly prescriptive, finding a balance between regulations and incentives (i.e. carrot and stick), and regulations that recognised those who have done environmental work through incentives and/or counter-incentives. These concepts were supported by the key informants. The widespread feeling among the interviewees was that there was a tendency for farmers to invest their energy in finding innovative ways to get around regulations, and reliance on regulations resulted in farmers only ever working to the limit allowed by rules. Therefore, it seems a balance between regulations and incentives would ensure that enforcement was available for those less-inclined to restore EF, while still allowing projects to be community-driven and for farmers to be encouraged to take ownership of their actions. F6 commented: "*it's not until farmers take ownership that you make progress.*"

Despite the numerous constraining elements of institutional and structural arrangements, it was identified that the vast majority of the participants (F1, F3, F4, F6, F7, and F8) experienced, or will potentially experience, a degree of facilitating influence from this factor (Table 13.12). For example, while institutional and structural arrangements did not motivate these farmers to develop their wetlands it added to the drive of their projects as they wished to use their wetland establishments to assist in future-proofing their farming businesses against anticipated regulations. Furthermore, F7 believed that some of their future wetland work would be policy driven as compliance-wise it would be easier for them to fence off small, wet areas than to convert them to paddocks through drainage. Overall, institutional and structural arrangements were never judged as being an enabling factor, however, it was only a constraining aspect for two farmers (F2 and F6, Table 13.13).

Table 13.13 Overall influence of institutional and structural arrangements for each farmer

FACTOR: Institutional and structural arrangements			
Theoretical influence			
Interviewee	**Constraining**	**Neutral**	**Enabling**
Farmer 1			
Farmer 2			
Farmer 3			
Farmer 4			
Farmer 5			
Farmer 6			
Farmer 7			
Farmer 8			

Farm characteristics

Farm characteristics were judged as constraining for two farmers (F1 and F2) who both operated dairy farms, which have higher land values (Table 13.14). Interestingly, while the evidence implies that this factor was a barrier for these two farmers, results from the research would suggest that they were able to overcome this constraint as both farmers were in good financial positions.

Contrary to most previous research, it was found that the size of the farms did not have an effect on the establishment of wetlands. For instance, although two of the farmers (F2 and

F3) had small to very small farms (300 ha or less, Table 13.14), they both had established large wetlands on their properties. An additional issue raised by F2 and KI3 was the difference in pest species between the North and South Islands of New Zealand, with those farmers in the North Island, in general, having to manage many more plant and animal pest species. This implies that North Island wetlands may have higher ongoing maintenance issues. In all, based on the above information, farm characteristics were deemed as enabling for the majority of farmers (F3, F4, F5, F6, F7, and F8, Table 13.15).

Table 13.14 Significant factors of influence on each farmer for farm characteristics

	F1	F2	F3	F4	F5	F6	F7	F8
FARM CHARACTERISTICS								
Dairy farm	■	■						
Sheep and dairy grazing farm			■					
Sheep and beef farm				■				
Sheep, dairy grazing, and beef farm							■	
Sheep, beef, and deer farm								■
Beef farm					■	■		
High stock units	■							
Very small farm (40-90 ha)		■				■		
Small farm (224-276 ha)			■		■		■	
Medium sized farm (325-456 ha)	■							■
Large farm (1430 ha)				■				
Located in the North Island	■	■			■			■
Located in the South Island			■	■		■	■	

Table 13.15 Overall influence of farm characteristics for each farmer

FACTOR: Farm characteristics			
Interviewee	**Constraining**	**Neutral**	**Enabling**
F1	■		
F2	■		
F3			■
F4			■
F5			■
F6			■
F7			■
F8			■

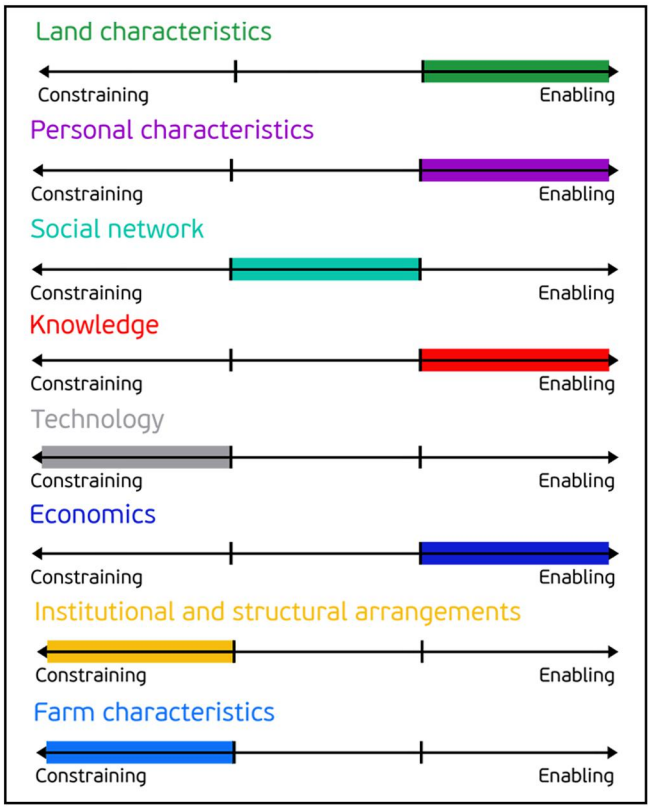
4.3.2 The relationship between motivations and influential factors

Not all interviewees were motivated to establish wetlands for the same reasons, therefore, analysis was conducted between those farmers who had similar motivations. By identifying the common enabling and constraining factors for those farmers who shared the same motivations for their wetlands it provided an interesting insight into how to address the barriers to, and opportunities for, developing wetlands at an individual project level.

Providing environmental benefits was a motivating factor for all farmers, although to varying degrees. Two of the farmers (F2 and F5) were strongly motivated to provide environmental benefits through their wetland developments, while F6 was equally motivated by both environmental and business benefits. A couple of farmers (F1 and F8) were strongly motivated by business benefits. Two farmers (F3 and F7) were greatly motivated by recreational and/or personal benefits; whereas F4 was mainly motivated by an equal mixture of business, personal, and recreational advantages.

Results show that land characteristics and personal characteristics were the common enabling factors for those farmers largely motivated by environmental benefits (Figure 4.0 and Figure 4.1). In addition, knowledge was a further enabling influence for farmers who were strongly driven by environmental gains (Figure 4.0). Farmers which included some element of business in their motivations commonly found land characteristics to be enabling (Figure 4.1, Figure 4.2, and Figure 4.3). Additionally, for those farmers who were significantly driven by business, economics and social networks were further enabling influences (Figure 4.2). Where recreational and personal aspects motivated farmers, land characteristics and farm characteristics were the common enabling factors, with economics being a constraining factor (Figure 4.3 and Figure 4.4). This analysis suggests that the establishment of wetlands on farms is significantly affected by the motivations of farmers and the end goals they have for their wetlands.

a) Farmer 2



b) Farmer 5

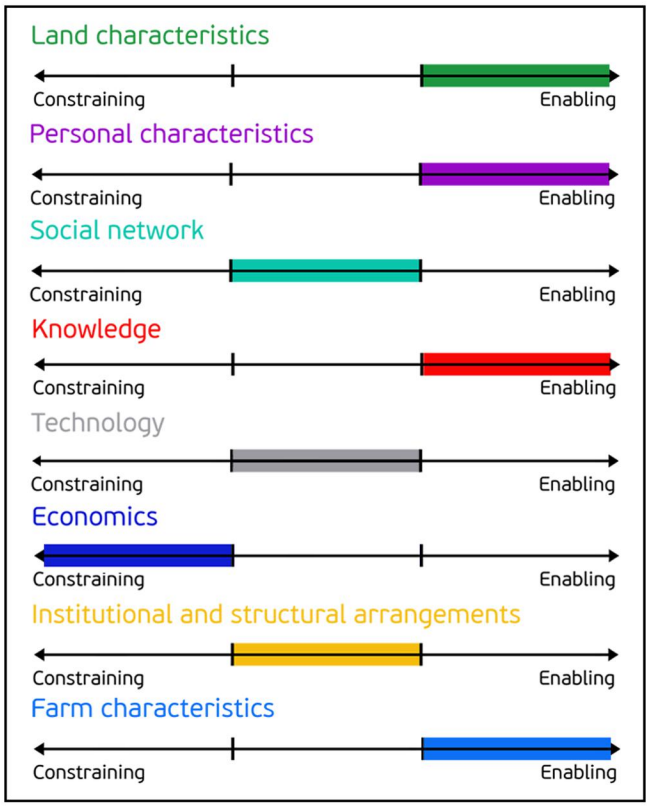


Figure 4.0 Continuum for farmers strongly motivated by environmental reasons

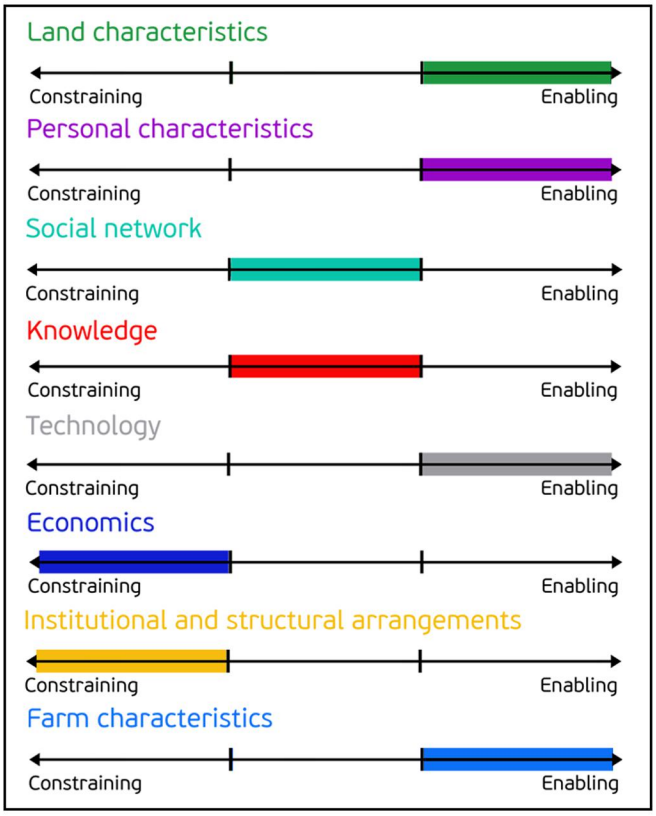
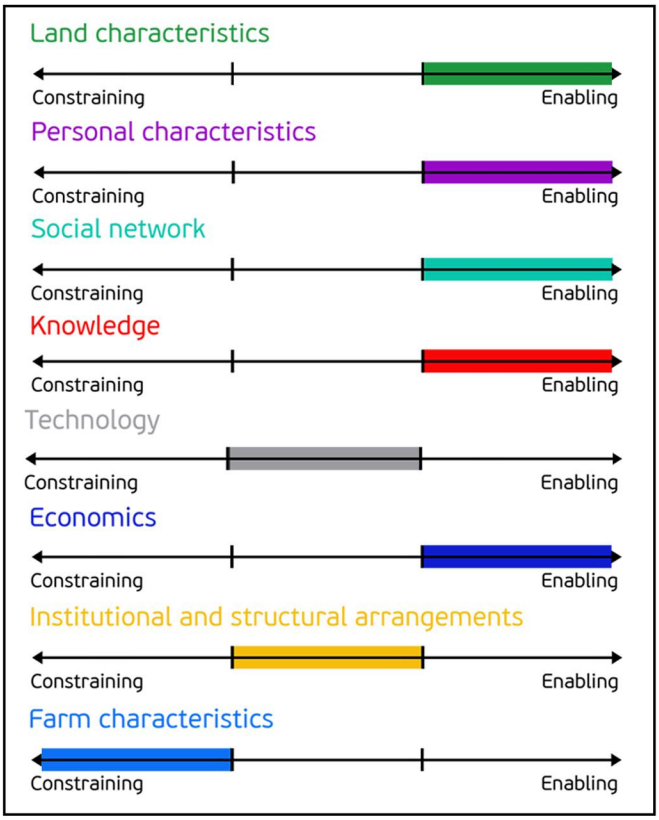


Figure 4.1 Continuum for Farmer 6 who was equally motivated by environmental and business reasons

a) Farmer 1



b) Farmer 8

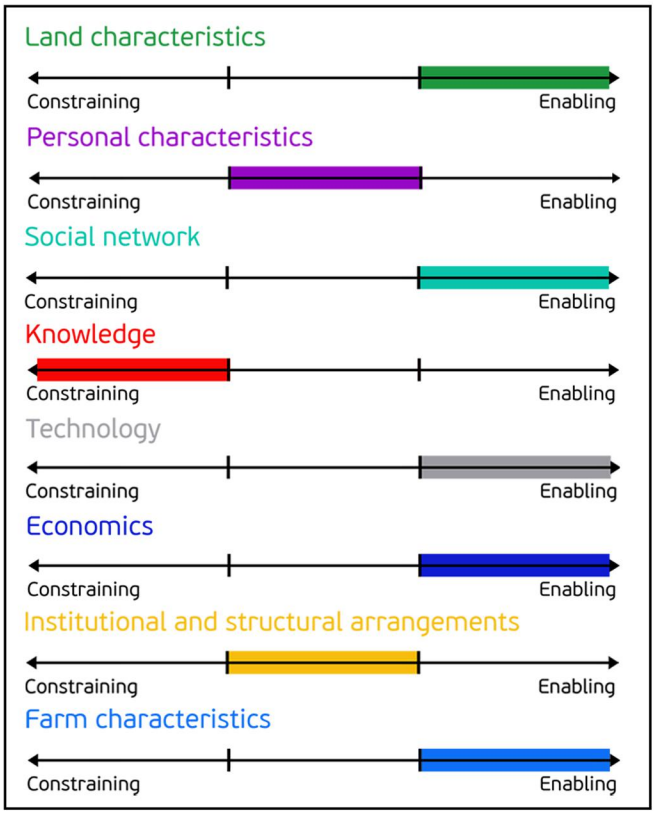


Figure 4.2 Continuum for farmers strongly motivated by business reasons

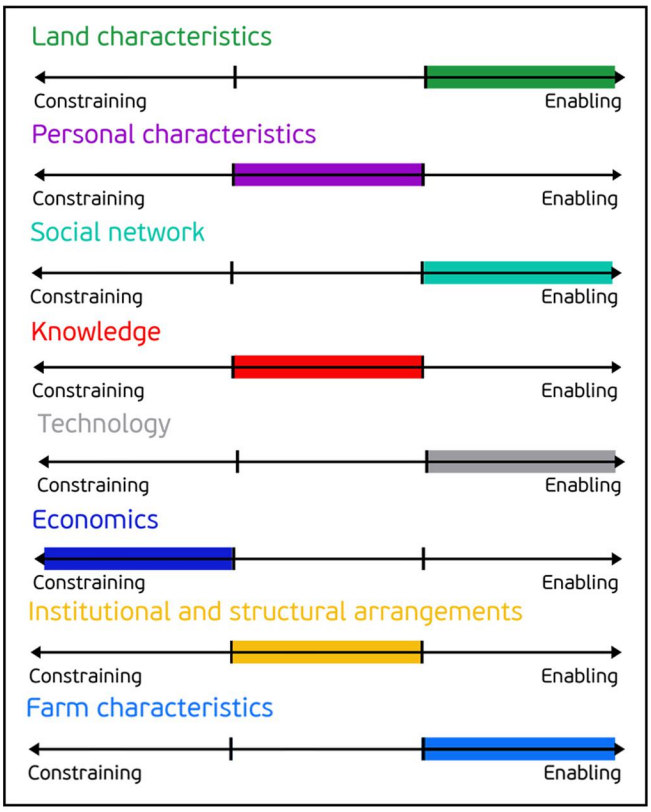
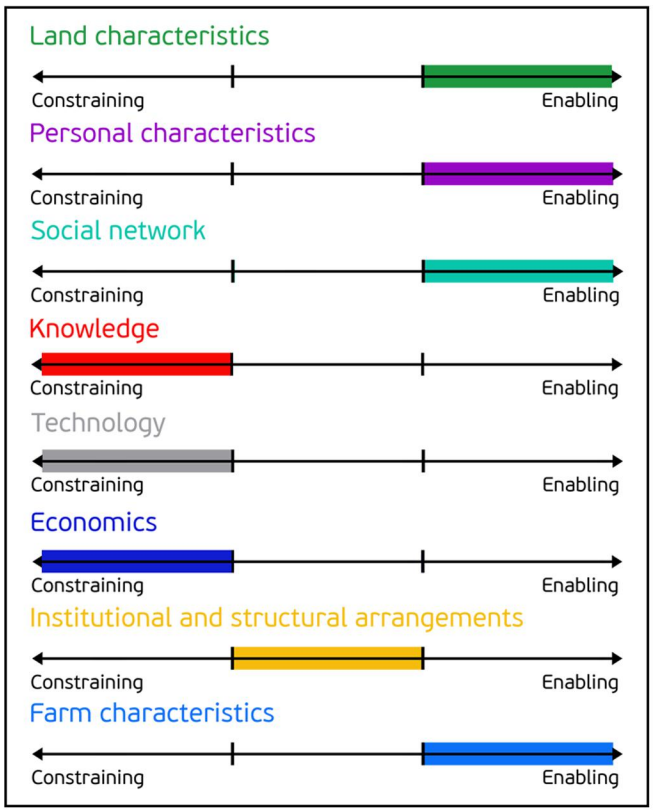


Figure 4.3 Continuum for Farmer 4 who was equally motivated by business, personal and recreational reasons

a) Farmer 3



b) Farmer 7

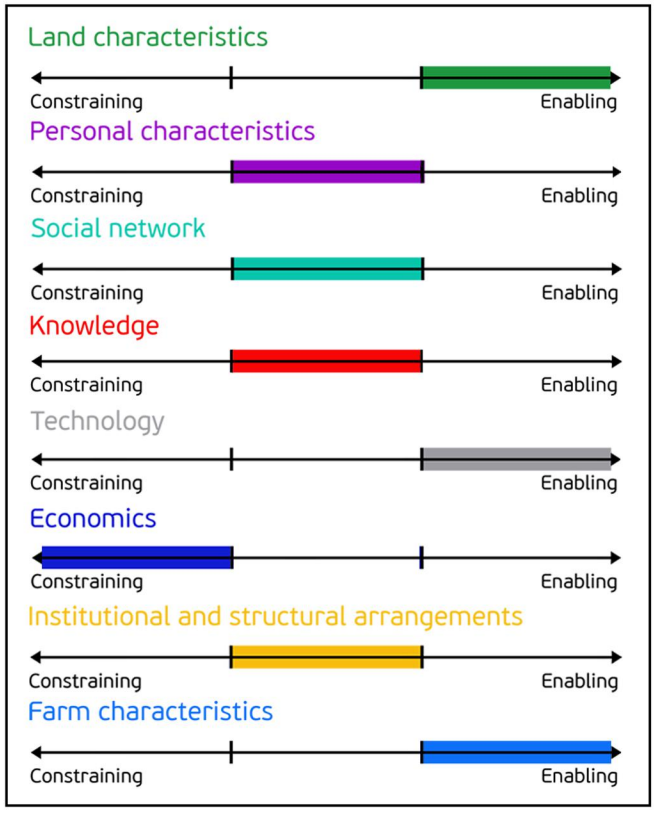


Figure 4.4 Continuum for farmers greatly motivated by recreational and/or personal reasons

4.3.3 New insights

Overall, the findings from this research broadly support the prevailing thinking in the literature. However, this study provides some interesting new insights into influential factors, which are summarised below:

- Age is less influential than the development of a farming business, with farmers who are more established but still expanding their farming operations being more likely to create wetlands than farmers who are still developing their farms;
- wetlands need to be considered beyond implementation, with the lifespan of the project taken into consideration, including the evolving motivations of farmers, the need for continual information and monitoring, and support with ongoing maintenance;
- community pressure is not always enabling, as it can damage small-town relationships;
- formal education is not highly influential on the establishment of wetlands;
- diversification of incomes, rather than purely off-farm incomes, should be considered when assessing the influence of economics;
- availability of time is an important enabling factor for wetland development; and
- the establishment of wetlands is not significantly influenced by farm size.

4.3.4 The outcomes of wetland development

Since creating their wetlands all the farmers (except F6 who is yet to implement their wetland) have initiated, or are thinking of initiating, further environmental plans on their farms (Table 14.0). Environmental initiatives include the placement of Queen Elizabeth II covenants on their wetlands, the implementation of more native planting, contemplating further wetland development, and improving the ecological function of their existing wetlands. These environmental actions may not directly be a result of their wetland developments but additional supporting comments from the farmers imply that the establishment of wetlands has the potential for encouraging further environmental work. For instance, F7 noticed a shift in their thinking since implementing their wetland, where their mind-set had changed from being focused on installing drainage to considering instead which areas they could fence off for wetland establishment. Similarly, F8 felt that

the environmental work they had carried out since the creation of their wetland was due to their wetland project increasing their appreciation for aspects of the environment.

Table 14.0 Outcomes of wetland development for each farmer

	F1	F2	F3	F4	F5	F6	F7	F8
OUTCOMES OF WETLAND DEVELOPMENT								
They have initiated, or are thinking of initiating, further environmental plans on their farm	■	■	■	■	■		■	■
They have a new appreciation for aspects of the environment			■				■	■
They have learnt about the purifying capabilities of peat	■	■						
They have learnt how to improve their wetland's ecological functionality			■		■			
Wetland is yet to be created						■		

4.3.5 Summary of interview findings

A complex interplay of factors influence farmers who are deciding to establish wetlands on their farms. Economics appears to be the most constraining factor, which is recognised in the research literature, yet it was not the most influential factor. For instance, land characteristics, personal characteristics, social networks, knowledge, and technology all had the capability of overcoming the potential barrier of economics (Figure 5.0). This research suggests that an essential element to encourage farmers to establish wetlands on their properties is to ascertain what their personal goals are, as well as their ambitions for their farming businesses. Once these are identified it is then possible to tailor wetland projects to assist in achieving farmers' aims.

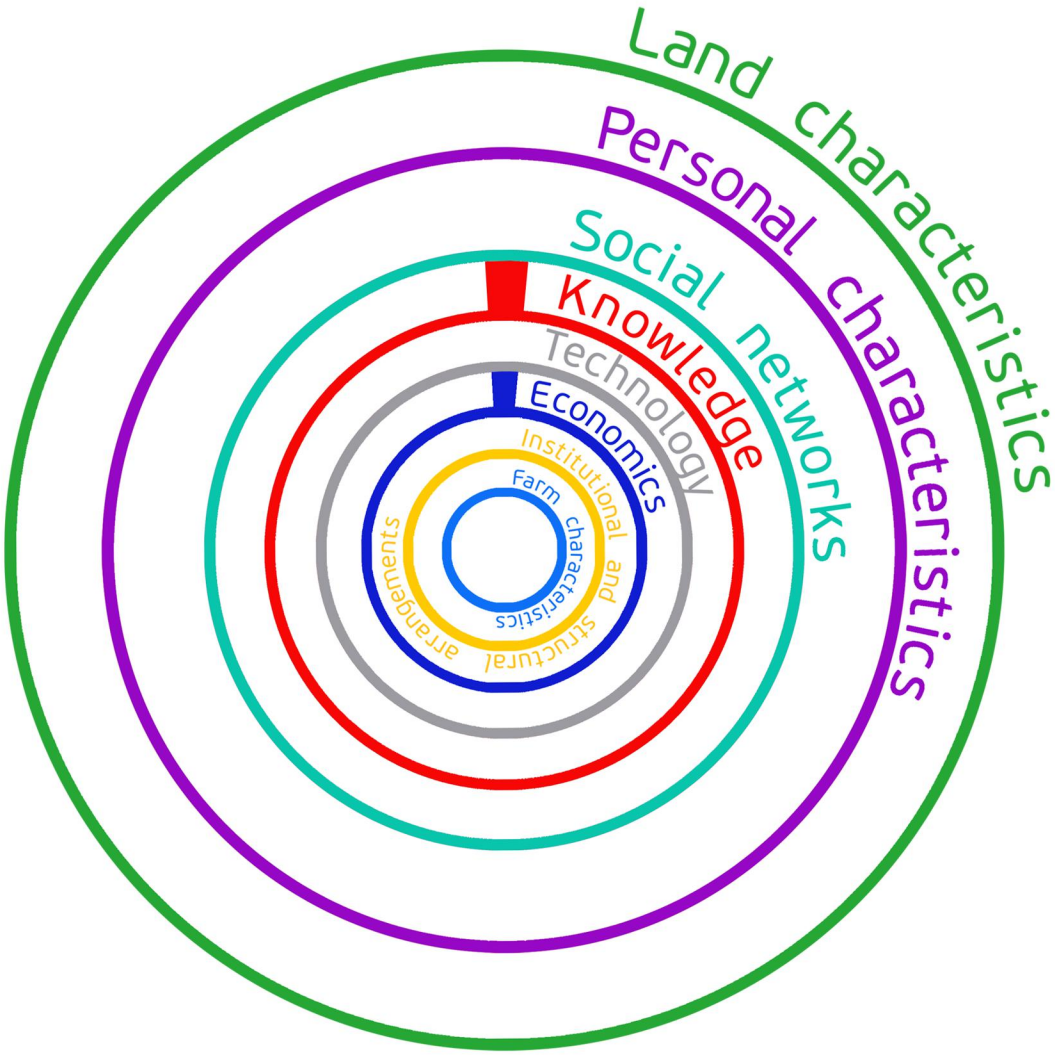


Figure 5.0 Concentric circles of influence: those factors on the outer edges of the circle have more influence on the development of wetlands than those in the inner circles. The strong relationship between 'social networks' and 'knowledge', and between 'economics' and 'technology', are acknowledged by the connecting lines.

5. Discussion

5.1 Introduction

The primary aim of this research was to investigate the barriers to, and the opportunities for, restoring ecological function on New Zealand farms, using wetlands as a specific example. Chapter Four discussed the key findings of this study from the survey and case studies. The results from both the survey and case studies indicate that there are no overriding factors which influence farmers in establishing wetlands on their farms. However, those survey respondents who had developed wetlands also had some or all of the following attributes: land which was suitable for the creation of wetlands; knew of others who had developed wetlands; were more formally educated; and operated well-established farming businesses with lower land value. Additionally, survey results show that economics was not a main motivating factor for farmers establishing wetlands but this was identified, overall, as a constraining influence for interviewees. That said economics was still less influential on interviewees developing wetlands than land characteristics, personal characteristics, social networks, knowledge, and technology.

This chapter discusses these key findings from Chapter Four firstly by reviewing the overall relevance of the eight main enabling and constraining factors, highlighted in Chapter Two, on the restoration of EF on farms in New Zealand. Secondly, it examines additional factors discovered in the study which influence farmers' decisions to restore EF and create wetlands. This is followed by a discussion about the strategies that could be used to promote more wetland development, and beneficial areas for further research. The chapter concludes by reflecting on the research, including lessons learnt and suggestions on what could have been done differently.

5.2 Influences on EF restoration in New Zealand

Participants in this research provided a range of perspectives on the barriers to, and the opportunities for, establishing wetlands on farms in New Zealand. The findings from this study largely support what the research literature reports as influencing farmers' decisions

towards EF restoration on their properties. However, the degree of influence some of these factors have on participants in this study differs from the literature.

5.2.1 The significance of economics

In general, the literature suggests that economics is the most significant factor of influence (Wilson, 1992; Welsch, 2011; Trevisan *et al*., 2016). In contrast, this study indicates that five of the eight main factors are more influential than economics, with land and personal characteristics representing the most significant of these factors. Both the survey and case study results show that economics were not as important to the establishment of wetlands as theory would suggest. For example, in the survey those farmers who identified economics as important also indicated that they highly valued their wetlands for beauty of the environment and leaving a legacy for future generations, thus, showing that economics was not an overriding factor. Additionally, the majority of the survey respondents did not expect a financial return from their wetlands. A study undertaken in Michigan, in the United States, by Ryan *et al.* (2003) found similar results when investigating the protection of riparian corridors on farmland. They suggest that farmers restored EF when they had an attachment to the land and wished to act as stewards for the environment, rather than by being motivated by economics (Ryan *et al*., 2003).

Likewise, economics was not the most significant influence for interviewees, and although economics was constraining in a number of cases, many interviewees showed an ability to overcome potential economic constraints with personal attributes, such as high motivation levels and their attitudes. Furthermore, while economic returns from wetland establishments were helpful, it was not an initial motivating factor for the majority of the interviewees. However, one interviewee (F4) in particular did appear to be more influenced by economics than the rest of the farmers. It is thought that this was because their farming business was relatively less established, which could have been a reflection of their younger age, and therefore they were less financially secure. Despite that, the wetland developed by F4 was relatively expensive and yet they were still able to contribute a significant amount of their own money to the project. This highlights the connection

between farmers' goals and the significance of economics, with more ambitious EF restoration projects potentially being more susceptible to the influence of economics.

Other factors within economics which differed in this study were access to funding, availability of time, and on-farm income diversification. In theory, funding is often deemed as necessary for the implementation of EF restoration, yet in this research some of the interviewees explicitly stated that they would prefer not to receive funding. For F3 this was because they were afraid of losing independence of their farm, an aspect which was noted in Chapter Two as being viewed as a sign of good farming in many countries' farming cultures (Carr and Tait, 1978; Barr and Cary, 2000; Pannell *et al*., 2006). Interestingly, Ahnström *et al*. (2008) found that in the United States, funding from the government for farmers undertaking environmental work made little difference to EF restoration efforts if farmers had negative attitudes towards EF restoration.

Availability of time was a factor indicated by some of the interviewees (F5, F6, and F8) as influencing their wetland establishment. Additionally, both the survey respondents and the case study participants identified on-farm incomes as their main source of revenue, however, some of the interviewees also indicated that they had off-farm incomes which had assisted in financing their wetland projects. This is supported by the literature in which a number of studies have found off-farm incomes as beneficial in encouraging the restoration of EF (Jellinek *et al*., 2013; Jellinek *et al*., 2014). However, in addition, some of the interviewees (F1, F5, and F8) were financially assisted in creating their wetlands through on-farm diversification. Time availability and on-farm income diversification are discussed in more detail in Section 5.3.

Although there was some significant variation between the influences of economics as identified by the research literature and what was found in this study (both in the survey and the case studies), there were still some consistencies. Of these the most notable was that those farmers who are more established in their farming businesses are more able to restore EF as they are more financially secure than those farmers who are still in the early stages of business development (Wilson, 1992; Wilson, 1997; Walford, 2002).

5.2.2 Prerequisite for wetland establishment

In general, both the survey and case study results support the literature regarding the influence of land characteristics. For instance, numerous studies have found that farms with areas of low agricultural productivity lend themselves to the restoration of EF (Wilson, 1992; Welsch, 2011). Similarly, in this research half of the interviewees (F3, F4, F7, and F8) indicated that the development of their wetlands did not, or would not, result in the loss of agriculturally productive land. Additionally, the survey suggested that those who had not established wetlands tended to operate farms with slightly less marginal land than those who had established wetlands. The survey and cases studies clearly indicated the obvious: if a farm does not have suitable land conditions for wetlands then wetland establishment will not eventuate. As this is a crucial first factor to consider, land characteristics were deemed as being highly significant when encouraging farmers to develop wetlands on their properties. In contrast, previous research generally highlighted a number of other factors, such as economics, as more influential than land characteristics. Wetlands have more specific geophysical requirements, such as appropriate topography, hydrology and soils, than general EF restoration, and therefore the difference in weighting for this factor between the literature and this research is likely a reflection of this.

5.2.3 Most influential factor

Figure 5.0, at the end of the results chapter, illustrates that land characteristics are more influential than personal characteristics. As discussed above, the sole reason for this is because without the presence of suitable land conditions wetland establishment is not feasible. Aside from this factor this study suggests that personal characteristics are the most influential factor on the development of wetlands on farms in New Zealand. The case studies specifically indicated that high motivation levels for wetland development, as well as the alignment of farmers' wider goals with their wetland projects, were very important. For example, all of the interviewees implied that wetlands were in line with their personal goals, and over half of the participants were highly motivated to create their wetlands. Overall, while the literature recognises the importance of understanding farmers' goals to encourage them to restore EF (Cary and Wilkinson, 1997; Söderqvist, 2003; Welsch, 2011), the influence of these goals are not weighted as significantly as in this study.

Furthermore, both the survey and the case studies reveal that farmers do not need to have environmental motives to create wetlands, which is contrary to the mainstream thinking in theory which suggests that farmers must perceive the presence of an environmental issue before they will restore EF (Cocklin and Doorman, 1994; Barr and Cary, 2000). Survey results found that environmental attitudes of farmers were not necessarily linked with the establishment of wetlands, and that some farmers who had established wetlands did not appear to be environmentally-minded. Likewise, although all of the interviewees were interested in providing environmental benefits through their wetlands, for a number of participants this was not an original motivation for establishing their wetlands and was something which became part of their goals as their projects progressed. These evolving motivations are discussed further in Section 5.3. In addition, only just over a third of the interviewees were strongly motivated by environmental reasons to develop their wetlands. This is important as it indicates that one way to increase a farmer's enthusiasm for EF restoration through wetlands would be to relate the wetland development to their own goals. Therefore, while a general approach can be applied to the restoration of EF, each EF restoration project should be individually tailored and involve close collaboration with the farmer (Kristensen *et al*., 2001; Yiridoe *et al*., 2010).

Interestingly, age appeared to have a different influence in this research when compared with the majority of the research literature. Generally in theory, younger farmers show a tendency to be more open to restoring EF (Dunlap *et al*., 2000; Jackson-Smith *et al*., 2005; Rodriguez *et al*., 2012; Ashraf *et al*., 2015), whereas the survey results suggest that as age increases so does wetland establishment. Research undertaken in the Cambrian Mountains, in Wales (Wilson, 1997), found that although age appeared to have some effect on farmers' participation in environmentally sensitive area schemes, its influence was not significant and it was thought that the influence of age differed for various EF restoration habitats. In the case studies for this research a similar pattern was discovered. In addition, the stage of business development appeared to be more important than age, with farmers who are well-established but still developing their farms being more likely to develop wetlands, than those who are younger and just starting their farming operations, or those

who are older and no longer developing their businesses. However, as both the survey and the case studies were not representative of farmers across all age brackets it is not possible to extrapolate from these results.

5.2.4 Access to information and peer pressure

In this study clear links were made between farmers' social networks and their knowledge. For example, in the survey it was found that farmers who had established wetlands were more likely to know of others who also had carried out wetland projects, while almost all the interviewees accessed information from their social network when developing their wetland. For some participants (F1 and F2) this was a major enabling factor for the establishment of their wetland. Although the literature mentions the importance of social networks for knowledge (Barr and Cary, 2000), the significance of formal education is given much greater precedence (Wilson, 1997; Jackson-Smith *et al*., 2005; Pannell *et al*., 2006; Welsch, 2011).

Interestingly, the survey appears to support the research literature, in that farmers who are more formally educated are more likely to establish wetlands. However, the case studies indicate that the potential constraints of lack of environmental knowledge when developing wetlands can be overcome by information from a farmer's social network. For instance, only half of the interviewees had a secondary school qualification at most but all participants were still well aware of the linkages between their farm and the surrounding environment. In Wilson's (1997) study in Wales, nearly two-thirds of their participants who were involved with a particular type of EF restoration scheme had low levels of formal education. However, they also found that respondents with higher formal qualifications were more likely to be involved with another type of EF restoration scheme, implying that formal education has differing influences on various EF restoration projects (Wilson, 1997). In this study it was suggested that social networks were more influential than knowledge when encouraging farmers to restore EF through wetlands.

Surprisingly, the case studies indicated different findings to the literature regarding the influence of peer pressure from farmers' social networks. Although both the research

literature and this study identified pressure from farmers' peers and families as the most influential aspects of farmers' social networks, the case studies in this research additionally found that while families were highly influential on farmers, not all family members equally affected farmers' decisions. Furthermore, although it has been found that pressure from farmers' peers is significant, results from the interviews indicate that different types of peer pressure have varying effects on farmers. For instance, half of the interviewees said that they had felt pressure from their peers not to establish their wetlands, however, this did not influence their decision to establish a wetland, and several had successfully influenced other farmers to develop wetlands on their farms. This shows that peer pressure can vary in form and significance, and it is possible for positive pressure from farmers' social networks to override negative social pressures.

5.2.5 Political environment

The case studies in this research and wider theory both suggest that institutional and structural arrangements are not sufficient enough to instigate environmental-behavioural changes in farmers without the influence of other factors (Cary and Wilkinson, 1997; Wilson, 1997; Barr and Cary, 2000; Bewsell *et al*., 2007). For instance, a number of the interviewees believed that farmers need to be encouraged to take ownership of their actions or they will only ever work to regulation limits. Overall, while institutional and structural arrangements were not suggested as having a significant influence, the need for farmers to 'buy-in' to wetland establishment was a crucial point emphasised by this research. Despite its lack of influence, institutional and structural arrangements do have the potential to become a significant constraint on the restoration of EF and therefore improvement of certain aspects of this factor would be beneficial. Section 5.4 discusses this in more detail.

5.2.6 Size and location

In general, it has been found that farmers who operate large-acreage farms are more likely to restore EF on their properties (Duke, 2004; Langpap, 2004; Gan *et al*., 2005; Lahmar, 2010). In contrast, this study found that larger farms do not increase the likelihood of wetland establishment. For example, in the survey there was no general pattern between farm size and those who had established wetlands. Likewise, in the case studies it was identified that

farm size was not significant on the development of wetlands, which was exemplified by two participants (F2 and F3) who had created large wetlands but owned small farms. Similarly, in an Australian study, in north-central Victoria, Pannell *et al*. (2006) found that tree planting on farms was not influenced by the acreage of the property, with farmers showing little variation in how many trees they planted regardless of the size of their farm. Therefore, the role of land character is more important that just size.

The difference in pest species between various areas of the country was an issue raised in the case studies and is specifically relevant to New Zealand. It was suggested by some participants (F2 and KI3) that there were significantly more plant and animal pest species which needed to be managed in North Island wetland projects than for wetland establishments in the South Island. This is important as more than half of the interviewees (F1, F2, F4, F5, and F8) identified ongoing maintenance as an actual, or potential, constraint on the development of their wetlands. Further exploration of ongoing maintenance is undertaken in Section 5.3.

5.2.7 New Zealand EF wetland establishment and current thinking

The influential factors identified in this research are largely consistent with current thinking; however, at times these factors had varying degrees of significance. Economics was the factor most obviously different in its level of influence, with the research literature suggesting economics as the most significant factor on restoring EF, while the results of this study indicated that other factors were able to overcome economic influences. In addition, contrary to the literature, it was found that farmers do not need to be environmentally-minded to restore EF. This was reinforced by the finding that farmers are motivated by a range of factors to develop wetlands, not just for economic advantages. This research indicates that aside from suitable land conditions for wetlands, personal characteristics (particularly farmers' goals and motivation levels) were the most significant factors for the establishment of wetlands on farms in New Zealand. Another issue that was specifically suggested as necessary in encouraging farmers to develop wetlands was the need for farmers to take ownership of their actions. Overall, it was believed that

environmental-behavioural changes would not occur until farmers bought into the idea of establishing wetlands.

Furthermore, some of the aspects within the eight main factors had a different influence on the participants in this study than was found in the majority of the literature. These aspects included motivations, age, formal education, and farm size. A number of additional factors of influence were also identified, including time availability, ongoing maintenance, and on-farm income diversification. Additional factors of influence, as well as some the significant differences between theory and this study are explored in more depth in the following section.

5.3 Additional factors of influence

Some of the findings in this research support a subset of literature which is separate to the mainstream thinking of EF restoration. The factors in this study that were identified as being more important than existing theory suggests include: changing motivations for wetland establishment, availability of time for developing wetlands, ongoing maintenance of wetlands, and on-farm income diversification.

5.3.1 Motivations for wetland establishment

As mentioned earlier, farmers in this research had a range of motivations for creating their wetlands. Interestingly, the case studies showed that as well as the existence of several factors which lead farmers to develop wetlands, these motivations were not static and continued to change as wetland projects progressed. It was found that these developments in motivations were often a reflection of farmers recognising the added benefits their wetlands could provide. For instance, while F3 initially established their wetland to create a duck shooting pond; once they had achieved this aim they realised the positive effect that their wetland was having on water quality and consequently modified their wetland to increase its effectiveness in filtering nutrients. This shows that while it is ideal to implement wetlands which restore EF, if there is an absence of this ecological aim in the initial development of a wetland it is possible that it will become part of the project as time progresses and the farmer realises the potential of the habitat they are creating. Pannell *et*

al. (2006) suggest that restoring EF should be treated as never-ending projects, in which farmers continually reassess their adoption of EF restoration based on their personal experiences. In order to ensure the EF of wetlands projects it would, therefore, be valuable for environmental advocates to continue to work with farmers on their wetlands beyond the implementation stage, which may support farmers in maintaining their motivation levels and assist in the recognition of further benefits that their wetlands could offer.

Additionally, two of the interviewees (F3 and F8) explicitly expressed that they had a new appreciation for aspects of the environment since creating their wetlands. For instance, F3 felt that if they had taken over ownership of their farm with the wetlands already established they would not have appreciated the wetlands as much as they do now. They explained that this was because of the prolonged effort that they had invested into the project, which had developed their great admiration for their wetlands. Interestingly, F8 believed that developing a conservationist attitude was a progression and not something which occurs overnight. They emphasised that people may set out to create a wetland for one reason but their motivations for its establishment will progressively expand as they recognise the additional benefits which wetlands can provide.

Furthermore, all the participants in the case studies are either in the process of, or considering, establishing further environmental initiatives on their properties, including improving the EF of their existing wetlands, as well as developing more wetland habitats. It is not possible to say for certain whether these additional conservation efforts are a direct outcome of the farmers' wetland projects, however, they do indicate that the participants have an increasing appreciation for the restoration of EF. In addition, four of the eight interviewees had undertaken environmental work prior to their wetland developments, which suggests that they may have been experiencing an increase in their appreciation for EF restoration before commencing their wetland projects. In some cases it appears this could have partially driven the farmers in developing their wetlands. For example, F8 explained that for them their increase in "green thinking" was a result of a series of environmental projects, starting with the establishment of shelterbelts. This corresponds with the research literature which finds that those farmers who have been involved with

past conservation efforts are more likely to be interested in further EF restoration schemes (Arano *et al*., 2004; Gan *et al*., 2005; Rodriguez *et al*., 2012; Jellinek *et al*., 2013; Carlisle, 2016).

Overall, it is suggested that while some farmers may have begun developing a deeper appreciation for EF restoration prior to engaging in their wetland work, the development of their wetlands has conceivably amplified their positive reception for EF restoration further. As such, it is reasonable to conclude that direct involvement of farmers in wetland projects is likely to result in farmers experiencing an increased awareness and appreciation of EF restoration, thus, emphasising the importance of creating opportunities for farmers to gain experience of wetlands first-hand.

5.3.2 Time availability

Availability of time was identified as having a significant economic influence on the establishment of wetlands by many of the case study participants (F1, F2, F5, F6, and F8). More than a third of the interviewees (F5, F6, and F8) identified time constraints as affecting the development of their wetland. A few studies in the literature discuss the barriers of EF restoration caused by a deficiency of available time but only in minimal detail. For example, Jellinek *et al.* (2013) imply that those farmers with more time could possibly find participation in EF restoration easier. Therefore, it is suggested that the long-term time requirements of wetlands are an important consideration if EF is to be successfully restored permanently on farms. Additionally, consideration should be given to ways to reduce time inputs into wetland implementation and ongoing maintenance.

5.3.3 Ongoing maintenance

A number of case study participants stressed the ongoing maintenance of wetlands as being, or as potentially becoming, a major constraint and emphasised the need for ongoing support with this issue. In contrast, when ongoing support is discussed in the literature, there is little to no mention of assistance with ongoing maintenance. For example, Attwood *et al*. (2009) found that Australian farmers require ongoing support in the form of monitoring and funding, and while this type of support may contribute towards reducing the barrier of wetland management, ongoing maintenance is not explicitly mentioned.

However, Bewsell *et al.* (2007) did briefly mention that some of the participants in their study on riparian management had concerns over weed management if they fenced the streams on their farm. Likewise, the Ministry for the Environment (2001) succinctly considered the need for ongoing maintenance in riparian plantings and state that continual management of revegetated areas is essential for the success of such projects.

The constraining influence of ongoing maintenance for wetlands is a fundamental finding for this research and raises the critical issue of wetland development needing to move beyond solely focusing on the implementation stage of projects and instead give consideration to the requirements of wetlands over their lifespan. It is suggested that some of the specific concerns that should be addressed include how to continue to support farmers over time; how to maintain farmer motivation levels for their wetland work; and developing methods to reduce ongoing maintenance of wetlands. It is possible that ongoing support could be provided through funding, as well as via the provision of labour.

5.3.4 On-farm income diversification

Previous studies predominately suggest that those farmers who supplement their incomes with off-farm earnings are more likely to undertake EF restoration projects (Barr and Cary, 2000; Welsch, 2011; Jellinek *et al*., 2013; Jellinek *et al*., 2014). Interestingly, some participants in the case studies (F1, F5, and F8) placed more emphasis on diversification of on-farm incomes, rather than increasing off-farm economic revenues. Examples of diverse incomes generated from on-farm activities included concerts, breeding and sale of extra bulls, and timber production. While all of the farmers relied on their farming businesses for their main stream of income, the ability to use their land to generate other forms of revenue was helpful in the development of their wetlands.

5.4 Restoring ecological function – where to from here?

As identified above farmers can encounter a number of barriers when restoring EF and developing wetlands; however, there are also various opportunities for neutralising these constraints. The following suggestions for addressing existing barriers are a result of

personal observations and interpretation of the data, as well as ideas suggested by participants in the study.

5.4.1 Political context

The wider political context sets the overarching framework in which farmers make managerial decisions about their farms. Although the case studies indicate that institutional and structural arrangements presented more of a potential threat than a realised constraint, there appears to be a number of areas for improvement which would further enable EF restoration on farms through the establishment of wetlands.

Resource consent was a major issue which was repeatedly mentioned, with most participants agreeing that implementation of wetlands would be less constrained if the cost of resource consents was reduced and if the application process was made easier. One suggestion put forward as a solution for improving the application process for resource consents was for the government to develop a form specifically tailored to wetland projects. Another idea proposed was removing the need for resource consents for those wetlands created on minor waterways. This implies that the adjustment of prescriptive policies to ones which are more flexible and objectives-led would assist in encouraging farmers to restore EF on their properties. This is supported by a study undertaken in Utah and Texas, in the United States, which investigated EF restoration on agricultural land and the perceptions over private property rights. It was found that there was variation in farmers' opinions over private property rights, with some landowners showing greater tendencies to focus on their individual benefits, while other landowners placed more importance on their societal responsibilities (Jackson-Smith *et al*., 2005). As such, they suggested that regulatory policies required flexibility in order to respond to these differing perspectives. For instance, it was proposed that incentives were likely to be the most effective means of restoring EF for those farmers with a strong interest in personal gain, while policies which encouraged farmers to voluntarily self-regulate may be more appropriate for those who have greater environmental stewardship (Jackson-Smith *et al*., 2005).

Participants also consistently voiced the need for policies to achieve a better balance between the carrot (incentives) and the stick (enforcement). In Australia, it has been found that the success of EF restoration is increased if incentives are applied but only if they are used in conjunction with compliance (Barr and Cary, 2000). The results from the case studies in this research indicate that participants believed farmers who are causing environmental damage are not being prosecuted, thus, suggesting that current legislation needs to be better enforced for those farmers who are not showing consideration for the environment. In addition, farmers felt that they received little recognition or reward from the government for their environmental efforts, and proposed that environmental initiatives should be factored into regulations. For instance, in return for undertaking EF restoration farmers could be rewarded by having fewer regulatory inspections on their properties. Furthermore, it is important that the positive environmental work being carried out by farmers, such as the establishment of wetlands, is reinforced. As Hervey and Hunter (2017) acknowledge, while the human brain is geared to take on negative news, it is positivity which mobiles people. This point was reiterated by F2, who believed that by reinforcing the positive, people will want to continue buying into improving the environment and being involved in the restoration of EF.

Cohesion and pragmatic knowledge within the government also needs to be addressed to assist in removing barriers towards EF restoration. Increased communication across government tiers and organisations would be beneficial, as would more on-the-ground training for government staff. A suggestion for improving staff training includes more contact with farmers through farm visits. Additionally, it may be advantageous to organise meetings between farmers who have restored EF and appropriate council staff to enable farmers to have the opportunity to voice areas where they may need more support. This cross-sectoral approach is likely to improve relationships and trust between farmers and government officials. A similar suggestion was made by Pannell *et al*. (2006), who believe that if environmental advocates collaborate with farmers in the restoration of EF then not only will it improve trust between the two parties but that it will also enable local knowledge to be incorporated into EF restoration programmes, and consequently improve EF restoration schemes.

5.4.2 Wider community setting

The wider community refers to people outside of the farming community. Numerous interviewees in the research emphasised the growing divide between rural and urban areas. They felt that this divide contributed towards the wider community's lack of acknowledgment of those farmers who have undertaken environmental work. It is important for communities to recognise these environmental efforts to encourage more farmers to adopt EF restoration, including wetland developments. As such, it is proposed that improving the wider community's direct exposure to EF restoration on farms is likely to increase their appreciation and support for the environmental work being carried out by farmers, as well as result in more informed consumers. Exposure could include organised community planting days or educational tours through EF restoration sites on farms. Additionally, Pannell *et al*. (2006) suggest that developing EF restoration projects which meet both the goals of the wider community and farmers is likely to reduce environmentally-based disagreements between the two parties. They believe this is especially important if an environmental concern of the wider community will result in the loss of economic profit for the farmer (Pannell *et al*., 2006). Furthermore, Jackson-Smith *et al*.'s (2005) Utah and Texas research identified that for EF restoration to benefit the wider community, it was important for the local and farming community to have shared values and interests, and to agree upon the use of common resources, such as water. They suggest the use of individual incentives for farmers to assist in bridging the potential gap between the goals of the wider community and the ambitions of the individual farmer (Jackson-Smith *et al*., 2005).

5.4.3 Farming community and farmers' social networks

It was found in both the survey and the case studies that farmers who had less exposure to wetlands were less likely to establish their own wetlands. It is suggested that one way of exposing farmers to EF restoration is to connect farmers with others in their social networks who have already restored EF on their farms. Likewise, Pannell *et al*. (2006) found that farmers who lived closer to others who had implemented EF restoration were more likely to restore EF themselves. They believe this could be due to higher exposure to EF restoration, or because the environmental work appeared more relevant to the farmers

(Pannell *et al*., 2006). Furthermore, Wilson (1997) discovered in their study in Wales that there was greater success in farmers adopting EF restoration if their neighbours had benefited from restoring EF. In particular they found that the most effective method for generating momentum was to initially approach farming community leaders to restore EF (Wilson, 1997).

Therefore, it is proposed that improving social network avenues for sharing knowledge and providing support would assist in developing collective interest in EF restoration, and increase shared environmental views within the farming industry. This could include facilitating the development of water and land care groups, or establishing an open-access national database for those who have established wetlands. It is envisaged that such a database would allow farmers, community groups, and organisations who have created wetlands to contribute information about their projects, including design details and where they accessed funding. This would give farmers who are contemplating wetland establishment a rich information source in one easy-to-access place, avoiding the need to "reinvent the wheel".

5.4.4 Issues at an individual scale

A number of potential constraints need to be addressed to encourage more farmers to restore EF through wetlands. Ongoing maintenance is one of the more important of these constraints, and is a potential issue which farmers need to be made aware of before they begin establishing their wetlands. As such, it is important that environmental advocates who are promoting the development of wetlands inform farmers at the outset of wetland projects of any potential maintenance requirements. Additionally, it is suggested that environmental advocates could assist farmers by providing labour and/or funding, or aid farmers in applying for these. Bewsell *et al*. (2007) suggest that demonstration sites could be used to show farmers examples of how to manage weeds in EF restoration projects. Other helpful measures environmental advocates could take include developing feasible management plans with farmers for their wetlands, as well as identifying methods for reducing the necessary up-keep of wetlands. In addition, participants identified that if various environmental advocates are working with a farmer to develop their wetland they

need to work together as lack of co-ordination between various parties can hinder the efficiency of projects. It is suggested that when multiple environmental advocates are involved in an EF restoration project they assign one representative as the contact person with the farmer.

It was believed by a number of interviewees that if farmers did not take ownership of their actions and water quality it would not be possible to encourage farmers to establish wetlands. To generate this ownership it is suggested that farmers are urged to test and monitor their waterways and discharges so they are able to observe the effects they may be having on water. It is thought once farmers recognise the impact they may be having it is more probable that they will take active measures (for instance develop wetlands) to increase their standard of water. An example of where water testing has encouraged farmers to take ownership of their actions is in Victoria, Australia, where test well flags were successfully used to raise the community's awareness of issues regarding irrigation on farms and salinity (Barr and Cary, 2000). These test flags clearly showed changes in water levels from irrigation, and while this test indicated water quantity, a similar concept could be applied for water quality issues. Additionally, as water monitoring can become costly it would be beneficial if farmers were provided with funding or subsidies for water testing. Ongoing monitoring of already developed wetlands could also be used to help sustain motivation for those farmers whose wetlands are functioning effectively, as well as highlight where EF of wetlands could be improved. Furthermore, monitoring results from well-performing wetlands could be used to encourage more farmers to implement wetlands by clearly demonstrating the benefits of these habitat types.

Although, the political environment has the potential to constrain farmers in restoring EF through the establishment of wetlands, it is important that this does not deter environmental advocates from encouraging farmers to restore EF and create wetlands. The framework in Figure 6.0 summaries pragmatic steps that environmental advocates can refer to when addressing potential constraining factors for wetland development at a project level within existing institutional constraints.

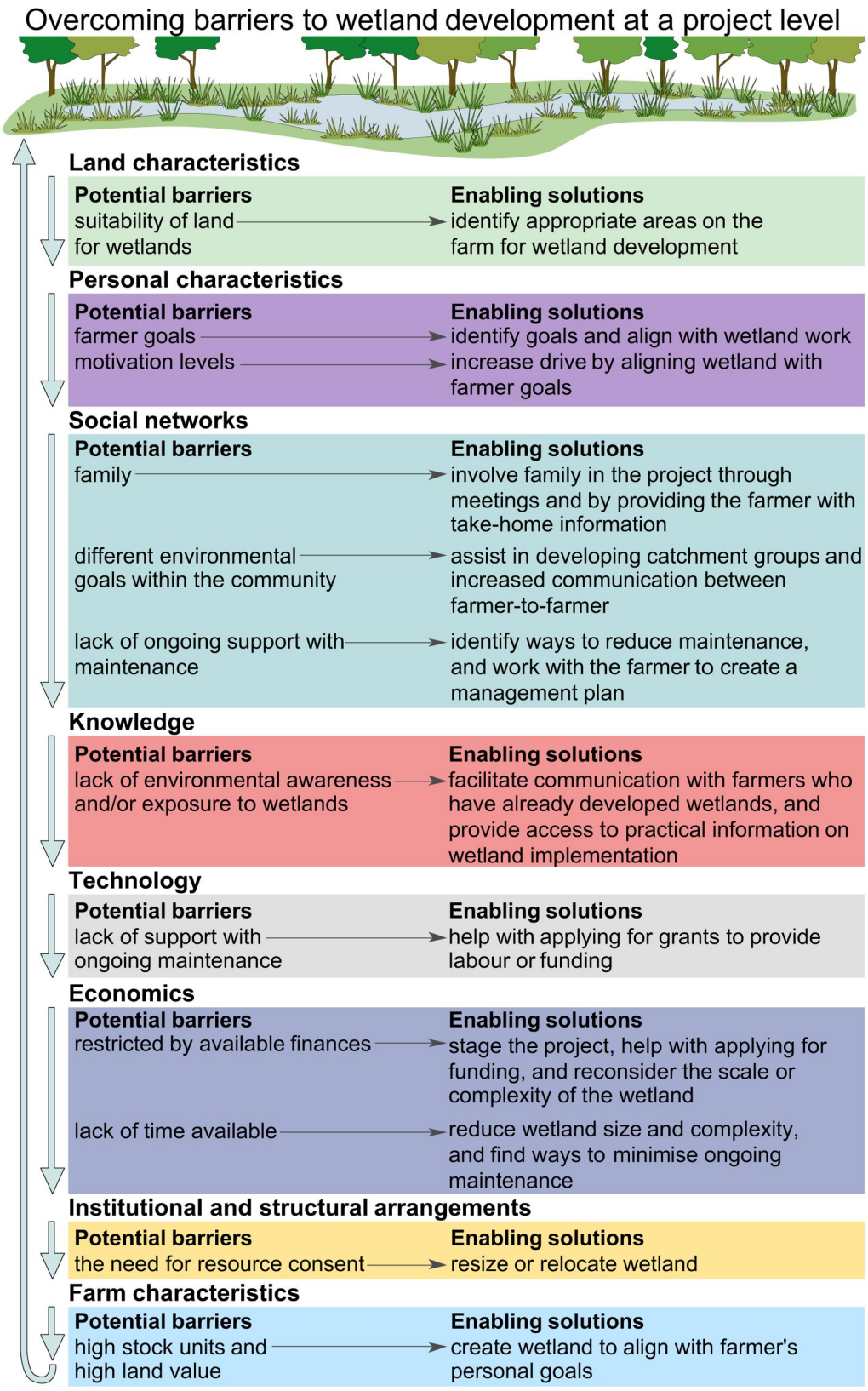


Figure 6.0 Provides a practical guide for overcoming potential constraints that may arise when working with farmers at a project level on wetland establishment. The most influential factors are situated at the top of the flow chart, with higher-up influences being capable of neutralising factors below. For example, land and personal characteristics can be referred to for overcoming social network constraints.

5.5 Further research

This research has uncovered a number of interesting points which would benefit from further investigation. It would be beneficial to conduct further research into farmers' changing environmental attitudes resulting from their involvement in EF restoration through wetland establishment, and it would provide a better understanding of farmers' motivations for restoring EF. While the literature has explored farmers' initial motivations for EF restoration, minimal regard has been given to the changing nature of these motivations. Further study into farmers' motivations for EF restoration and wetland development is important as their goals and motivations were identified in this research as one of the vital components in encouraging farmers to create wetlands on their properties.

Investigation into methods for reducing ongoing maintenance of wetland developments is another valuable area for further research. This could include exploring the difference in ongoing maintenance for various wetland designs, as well as efficient maintenance methods which decrease time required for wetland up-keep. Finding ways to reduce ongoing maintenance of wetlands is especially important for those farmers who have less time available or are less driven to create wetlands.

The results from this research imply that older farmers are more likely to establish wetlands, and that this might be connected with the development stage of a farming business. However, as the study is not representative of all farmers and given this apparent relationship, further research is needed to confirm this. If further investigation did show a statistical relationship it would be important to consider the implications of this finding. A small number of studies also found that age was not highly influential, with some research suggesting that the influence of age varied depending on the type of habitat restored. Therefore, further research into the influence of age on the EF restoration of various habitats could assist in understanding if particular EF restoration projects are more likely to be adopted by certain age groups, and whether age is actually a reflection of business development instead.

The influence of formal education on the establishment of wetlands was also identified as varying from the mainstream thinking in the literature. This research suggests that informal learning, through personal experiences and social networks, can be as influential as formal education. Further investigation into the influence of education on EF restoration through wetland development could assist in understanding the benefits of supporting different forms of education.

5.6 Research reflections

To understand the influences on farmers establishing wetlands, this research investigated the issue at both a national scale through surveys, and in greater depth through multiple case studies, which involved semi-structured interviews. This approach enabled the research to explore in detail the factors influencing farmers in developing wetlands, which could then be contextualised by the broader information. Both surveys and semi-structured interviews are common social research methods (Neuman, 2011) and were appropriate choices for this study, yet all methods contain restraints, some of which were encountered in this research. The constraints of this study are discussed, followed by an overall reflection of the research strategy employed.

The main restriction for this study was the sampling approach for the survey, which relied on the self-election of farmers to complete the questionnaire. This kind of convenience sampling, rather than non-probability sampling techniques, is less reliable for generating a representative sample (Bryman, 2001; Neuman, 2011; Halperin and Heath, 2012). As mentioned in Chapter Four, this method was utilised as there is no public national database of farmers to sample from. It is likely that the uneven representation of some variables in the survey was a reflection of this chosen approach. Variables which did not display a wide distribution included age, with few respondents being under thirty years, and wetland development, with the majority of participants having had established wetlands or were open to the concept of creating wetlands. In addition, it is likely that those farmers who answered the survey are biased towards establishing wetlands as it is unrealistic to expect farmers with little or no interest in wetlands to have taken the time to answer the survey. However, as the aim of the study was to provide a national perspective of wetland

establishment on farms this appeared to be the only viable option available and was considered acceptable as the information was to be verified through triangulation with data gathered from multiple case studies (Bryman, 2001; Neuman, 2011).

An additional potential constraining factor of the survey was its online nature, which relied on respondents having access to the internet and computers, as well as being computer literate (Neuman, 2011; Halperin and Heath, 2012). The survey was predominately advertised via online newsletters, which may have restricted the types of farmers able to access the survey. Due to the time and money constraints of the research, it was deemed that an online survey was the most feasible option for gaining the most respondents in a relatively short timeframe for no expense. Positively, the questionnaire appeared to be well-designed as the majority of the surveys were completed, with only one respondent commenting negatively on the wording of the questions.

The multiple case study component of the research had few restrictions, although there were three areas for possible improvement, including the creation of the interviewee short list. Potential interviewees were added to a short list and were sourced through interested survey respondents, as well as through names provided by Fish and Game, and the National Wetland Trust of New Zealand. While this approach enabled the identification of appropriate case studies for the research, it is possible that the study would have benefited from further investigation of potential case studies through other avenues, including the media and documentaries. Furthermore, while all but two of the interviews were carried out in-person it would have been advantageous if this had been possible for all of the cases. It was found that those interviews undertaken face-to-face greatly increased the depth of information which was gathered, including anecdotal information from seeing the wetlands themselves and interactions with family members (Bryman, 2001; Neuman, 2011; Halperin and Heath, 2012). In addition, it may have been worthwhile to interview farmers who had not established wetlands, to enable comparisons to be drawn between those that had and had not developed wetlands on their farms.

As described above, the research was sometimes restricted, nevertheless, these shortcomings were often unavoidable due to the restricted time and financial constraints of the study. Despite these restrictions, the research has provided some findings into the barriers to, and the opportunities for, restoring wetland EF on privately-owned New Zealand farms which are both insightful and at times novel. These results form a sound basis for more investigation into the specific barriers identified in the research, and provide an initial framework for approaching the issue of facilitating EF restoration, through wetland development, in practice. It is anticipated that the results from the study will help both farmers and environmental advocates in further establishing EF wetlands on farms throughout New Zealand.

6. Conclusion

6.1 Main findings

Globally there is an overall downward trend in the ecological functionality of agricultural landscapes. In certain countries, much of this farmland is privately-owned, therefore, it is important to understand how to encourage and engage farmers in restoring EF (Badgley, 2003; Allan, 2004; Stuart and Gillion, 2013). Waterbodies are highly susceptible to surrounding land uses and scientific research shows that agricultural activities can negatively affect their quality (Larned *et al*., 2004). There are various ways of addressing the issue of EF restoration and water quality, with wetland development representing one solution. In New Zealand almost half of the country's total land area is covered by pastoral landscapes (Ministry for the Environment and Stats NZ, 2017) and around 95 percent of New Zealand wetlands have been lost as a result of development (Hunt, 2007; Myers *et al*., 2013). Therefore, the purpose of this research was to investigate the barriers to, and the opportunities for, restoring wetland EF on privately-owned New Zealand farms.

An online survey was employed to establish information on the issue at a national scale. In addition, case studies with semi-structured interviews were used to provide detailed information, which could be contextualised by the survey. From reading the research literature it became clear that there were eight major factors influencing farmers' decisions on EF restoration. Results from both the survey and case studies largely supported these findings; however, the weighting of these influences were not always consistent.

In the literature, economics is generally highlighted as the most influential factor. Interestingly, in this research results from both the survey and case studies suggested that economics were less significant than other factors, with land characteristics, personal characteristics, social networks, knowledge, and technology all identified as being capable of overcoming potential economic constraints. For instance, land characteristics were deemed as the most influential factor on the development of wetlands, as land conditions need to be suitable if a wetland is to be established. The second most significant factor identified in this study was personal characteristics. Specifically, it was shown that it was

important for wetland projects to align with farmers' wider goals, which increased their motivation to develop their wetlands. Additionally, unlike previous research, this study revealed that pro-environment attitudes were not a pre-condition for wetland establishment. For instance, some farmers established their wetlands for other reasons, such as recreational use or aesthetics.

Institutional and structural arrangements did not appear to be highly influential, however, an essential point highlighted in this research was the need for farmers to 'buy-in' to wetland establishment. It was believed that the success of wetland developments would be greatly increased if farmers were motivated to create wetlands and recognise the benefits of restoring EF without the enforcement of regulations. Furthermore, this study revealed some additional influences that, in general, were not emphasised in the literature. For example, it was found that motivations of farmers to create wetlands changed as wetland projects progressed, and were often a result of farmers recognising the added benefits of their wetlands over time. Availability of time was another aspect identified as having a significant influence, with wetland establishment being negatively influenced when farmers had less disposable time.

Overall, while it is apparent that there are several interacting factors which influence farmers restoring EF through wetlands, evidence indicates that a vital component in encouraging farmers is to recognise their personal goals and ambitions for their farm. When these goals are identified then it is possible to develop wetland projects which are in line with these aims.

6.2 Recommendations

A number of recommendations have been put forward in response to some of the findings in this research. In light of the fact that farmers' motivations change as wetland projects progress, it is recommended that farmers who are keen to establish wetlands are provided with ongoing support throughout their projects by councils, as well as industry partners, and environmental organisations (such as the Department of Conservation and Royal Forest and Bird Protection Society of New Zealand). These supporting groups could

provide ongoing information to farmers on the additional benefits their wetlands could provide, as well as offer knowledge on wetland adaptations that may be required to achieve these added benefits. In addition, it was found that farmers had a better appreciation for wetlands if they had been previously exposed to EF restoration. As such, it is recommended that opportunities should be created by these groups to give farmers more first-hand exposure to wetlands and wetland restoration. This could include asking farmers who have established wetlands on their properties to use their wetlands as demonstration sites for others who are interested in undertaking similar projects.

Availability of time can be constraining for farmers establishing wetlands and, therefore it is suggested that wetland advocates (such as councils, environmental organisations, industry groups, and Fish and Game) consider the lifespan of wetland projects when advocating them to farmers. This includes informing farmers about the ongoing time requirements that may be needed for wetland projects, and considering how this will work with the farmers' time availability. It is also recommended that research be conducted by these organisations, or supported through universities, on realistic methods for reducing ongoing maintenance. For instance, ideal planting densities for reducing issues with weeds, maintenance methods (chemical versus mechanical), and the use of temporal stock access for weed management.

The establishment of wetlands will be more successful if farmers are willing to create wetlands without the enforcement of regulations. Thus, it would be beneficial for central, regional, and local governments to explore ways of successfully creating rules under the RMA and council plans which are flexible and outcome-focused (rather than overly prescriptive), and regulations which provide a balance between the carrot (incentives) and the stick (enforcement).

Other recommendations include reducing the divide between the farming community and the wider community, increasing farmers' exposure to wetlands, and encouraging farmer ownership of their on-farm activities and their connection with water quality. It is suggested that direct exposure to EF restoration projects is likely to increase the wider

community's awareness of these projects, and could be in the form of community planting days or educational tours. These could be organised by land and water care groups, as well as councils, and industry partners.

Similarly, farmers who have more first-hand experience with wetlands are more likely to be motivated to create their own wetlands. It is recommended that developing connections between farmers who have and have not established wetlands would be beneficial. This could be done through the creation of water and land care groups, which are driven by the farming community but supported by environmental organisations, councils, and industry partners. In addition, it is recommended that central government creates a national database on established wetlands, which could be used as a reference site for those considering developing a wetland. The database could be an open platform where individuals or groups who have established wetlands could provide information on their projects, including where they accessed funding and their design considerations.

Finally, to improve farmer ownership of their on-farm activities and the effect these have on water quality, it is recommended that councils and industry partners encourage farmers to test and monitor their waterways. As a result farmers will be able to see what effects their farm activities may be having on water health. It is suggested that once farmers observe the impact they may be having it is more likely they will take action to remedy any negative effects.

6.3 Future research opportunities

A number of interesting points were raised during this study which would benefit from further investigation. Research possibilities include exploration of the development of farmers' environmental attitudes during EF restoration projects, ways to decrease the ongoing maintenance of wetland establishments, and the significance of a farmer's level of formal education and age on EF restoration and wetland development. Contrary to the literature, this study suggested that informal learning has the potential to be as influential as formal education and thus there are research possibilities in investigating the benefits of various types of learning. Similarly, significance of age varied between this research and

previous studies. In this study it appeared that older farmers were more likely to establish wetlands, while in the literature it is generally indicated that younger farmers are more open to the concept of EF restoration (Dunlap *et al.*, 2000; Jackson-Smith *et al*., 2005; Rodriguez *et al.*, 2012; Ashraf *et al*., 2015). However, as this study is not representative of the whole farming community, further research is needed to confirm this relationship.

6.4 Final remarks

Overall, this research has identified that there is a great need to focus on the EF of privately-owned farms if we are to address the issue of degrading water quality. In addition, it recognised the serious decline of wetlands and the potential to use these habitats as a solution for restoring EF on farms. It was revealed that finding an answer to this problem is not easy as there are several complex and interrelated factors which influence farmers' decisions regarding EF restoration.

Importantly, however, it was found that specific consideration should be given to a farmer's personal goals, as well as their ambitions for their farm, for successful EF restoration through wetland development. As Hervey and Hunter (2017) note, if we want to create positive environmental change we need to connect to people's personal stories.

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Appendices

Appendix A: Online survey

Survey on establishing wetlands on agricultural land

The aim of this survey is to find out about farmers' views on establishing wetlands on their agricultural properties, as well as what influences those views, and if the establishment of wetlands is a practical strategy for improving water quality.

Wetlands are defined by the Resource Management Act as "permanently or intermittently wet areas, shallow water, and land water margins that support a natural ecosystem of plants and animals that are adapted to wet conditions." For the purposes of this survey, wetland establishment refers to establishing wetland areas with the intention of creating habitat for wildlife. It does not include riparian planting or water storage for livestock or irrigation.

This survey will take about 15 minutes to complete. It will ask a series of questions about your views on and experiences with wetland establishment on the agricultural land you currently own or lease.

If you have any questions about this project please feel free to contact Chantal Whitby at which356@student.otago.ac.nz or her supervisor Prof. Richard Morgan at rkm@geography.otago.ac.nz.

This project has been reviewed and approved by the Department of Geography at the University of Otago and meets University of Otago ethic requirements.

Consent Form for Respondents:

I have read the information provided above and in the advertisement and understand what it is about. Any questions I have had have been answered to my satisfaction. I understand that I am free to request further information at any stage.

I know that:

1. My participation in the survey is entirely voluntary.
2. I am free to withdraw from the survey at any time without any disadvantage.
3. The survey is completed anonymously unless respondents wish to voluntarily provide contact details at the end. Data will be aggregated and it will not be possible to identify individuals.

4. Personal identifying information (names and contact details if voluntaried) will be destroyed at the conclusion of the project but any raw data on which the results of the project will depend will be retained in secure storage for at least five years.
5. The results of this project will form the basis of Chantal Whitby's thesis research for her Master of Science in Environmental Management. The thesis will be available at the University of Otago Library (Dunedin, New Zealand) and may be published but every attempt will be made to preserve my anonymity.

I have read and understood the above provisions and consent to be a participant in the project on the terms set out above:

Yes

No

NOTE: if you currently own or lease more than one farm please base your answers on the property which you feel best represents your efforts in wetland establishment or your main/most important property if you have not established wetlands.

INVOLVEMENT IN WETLAND ESTABLISHMENT

1. (a) Does the agricultural property that you currently own or lease have any existing wetland areas (other than stream and river margins)?

   Yes

   No

   (b) Have you established/are you establishing a wetland area(s) on the agricultural property that you currently own or lease?

   Yes

   No

   If your answer is 'No' please go to question 4.(a)

   (c) Which of the following types of land did you establish your wetland(s) on?

   Unproductive land

   Productive land

   Both unproductive and productive land

   (d) Out of the total land area of the farm, what percentage do you estimate is, or will be, covered by the wetland area(s) you have established/are establishing?

   5% or less

   6-10%

   11-20%

   21% or more

---

2. (a) How many years ago did you begin establishing your wetland area(s)?
   5 years ago or less

6-10 years ago
11-15 years ago
16 years ago or more

(b) Establishing wetlands can involve a number of activities. Please tick any that you have carried out in your own wetland work.

Removal of drainage to allow water back onto the land
Diverting water courses/channels
Restoring waterways to their unmodified state
Physical modification of the land, e.g. earthworks
Weed and pest control
Creation of habitat through native planting
Creation of habitat through exotic planting
Exclusion of stock
Control of nutrient runoff from surrounding land
Other (please specify)_____

---

3. (a) This is a list of factors that previous research has found to motivate farmers to establish wetland areas. Please rank each factor on a scale from unimportant to very important.

	Unimportant	Important
Improvement of water quality		
Economic advantages		
Compliance with the law		
Legacy for future generations		
Erosion control		
Flood control/stormwater management		
Recreation		
Beauty of the environment		
Habitat for native plants and animals		
Habitat for game species		

(b) In some cases wetlands can provide a financial profit to farmers, such as by protecting land from flood damage. Not everyone expects the establishment of wetlands to result in a financial profit but those that do have varying opinions on when to expect a profit. Which of the following best describes your perspective on financial profit?

No financial profit expected
Financial profit expected 5 years or less after wetland establishment
Financial profit expected 6 to 10 years after wetland establishment
Financial profit expected 11 years or more after wetland establishment

(c) Have you ever received any funding or assistance (e.g. money, plants/materials or guidance on establishing wetlands) from any government or non-government organisations for carrying out wetland establishment?

Yes

No

If 'Yes' which organisation(s)?_____

Please go to question 5.(a)

FUTURE INTEREST IN WETLAND ESTABLISHMENT

4. (a) Would you consider establishing wetlands on the agricultural land that you currently own or lease?

   Yes

   No

   If your answer is 'No' please tick as many of the following that describe your answer:

   I'm not interested in wetlands
   I don't have the money to establish wetlands
   The physical nature of the land isn't suitable for wetlands (i.e. high country)
   It isn't something that I have considered before
   Other (please specify)_____

   (b) Have you established habitat types other than wetlands on the farm you currently own or lease?

   Yes

   No

5. (a) Please indicate how much you agree or disagree with the following statements.

	Strongly Agree	Agree	Neither Agree or Disagree	Disagree	Strongly Disagree
Conservation is a major part of my land management aims	○	○	○	○	○
Making environmentally-conscious choices in my day-to-day life is not something that is important to me	○	○	○	○	○
Wetlands are not beneficial for farm productivity	○	○	○	○	○
Wetlands are important for keeping ecosystems healthy	○	○	○	○	○

(b) If there are wetlands in your local area, do you carry out any of the following activities on these wetlands? (Please tick those that are relevant to you)

Kayaking/boating

Duck shooting

Walking/tramping

Fishing/food gathering

Bird watching

Other (please specify)_____

There are no wetlands in my local area

There are wetlands in my local area but I'm not an active user of them

6. (a) Please indicate with a tick if you are a current or past member of any of the following groups.

NZ Farm Environment Award Trust (NZFEA)	Current	Past
NZ Farm Forestry Association (NZFFA)	Current	Past
QE II National Trust	Current	Past
National Wetland Trust of NZ	Current	Past
Royal Forest and Bird Protection Society	Current	Past
NZ Plant Conservation Network	Current	Past
NZ Native Forests Restoration Trust	Current	Past
NZ Ecological Society (NZES)	Current	Past
WWF – NZ	Current	Past
Greenpeace NZ	Current	Past

Friends of the Earth NZ	Current	Past
Other (please specify)_____	Current	Past
None of the above		

(b) Are you aware of any government or community initiatives in your local area for establishing wetlands?

Yes

No

If 'Yes' have you ever been involved with any of these initiatives?

Yes

No

(c) Do you know if any of your friends, neighbours or people in your community have carried out wetland establishment on their properties?

Yes

No

FARM CHARACTERISTICS

7. (a) Which of the following best describes your farming operation?

Dairy

Beef

Sheep

Beef and Sheep

Deer

Arable

Other (please specify)_____

(b) What is the size of the farm you own or lease?

50 ha and under

51-200 ha

201-400 ha

401-800 ha

801 ha and over

(c) Do you own or lease the property that you currently farm?

Own

Lease

Own part and lease part

(d) As an estimate, what percentage of the total farm area is currently being used productively?

50% or less

51-75%

76-90%

91% or more

(e) On average through the year, how many full-time equivalent people work on the farm?

1-5

6-10

11-15

16 or more

(f) Has the farm been owned by previous generations in your family (including in-laws)?

Yes

No

If 'Yes' how many generations has the property been farmed by your family?

2 generations (e.g. farmed by your parents)

3 generations (e.g. farmed by your grandparents)

4 or more generations (e.g. farmed by your great-grandparents or great-great-grandparents)

PERSONAL INFORMATION

All data is absolutely confidential, no individual will be identifiable from the results.

Please tick the boxes which relate to you.

8. (a) Gender:

Female

Male

(b) Age category:

20 and under

21-30

31-40

41-50

51 and over

(c) Ethnic group (please tick those which apply to you):

NZ/European

Maori
Polynesian
Other (please specify) _____

(d) Have you lived most of your life in the area you are currently farming?
Yes
No

(e) What is the highest qualification you have completed?
Secondary school qualification
Tertiary diploma or certificate
Bachelor degree
Postgraduate qualification

9. (a) Is farming the primary source of income for your household?
Yes
No

(b) How long have you been farming?
5 years or less
6 – 10 years
11 – 20 years
21 years or more

(c) How many years have you been farming the current property you own or lease?
5 years or less
6 – 10 years
11 – 20 years
21 years or more

Do you have any comments about aspects of this survey that you wish to add?
_____
_____
_____

If you have been involved in wetland establishment and would be willing to be part of the case study component of this research, please provide your contact details below:

Name:_____

Phone Number:_____

Email:_____

Thank you for taking the time to complete this survey

Appendix B: Interview structure

Farmers' Perspectives on Wetland Establishment on Agricultural Property

INTERVIEW SCHEDULE

1. **General information:**
    a. Gender:
    b. Age:
    c. Farm type:
    d. Size of the farm:
    e. Wetland area:
    f. When wetland work started:

2. **Initiation of wetlands work:**
    a. Can you please tell me a bit about your wetland project?
    b. What motivated you to undertake your wetland work?

3. **The process:**
    a. What do you think were the main barriers for you when you were developing your wetland?
    b. What do you think were the main aspects which encouraged you with your wetland work?

4. **Influences:**
    a. Who do you think has most influenced you when making decisions about your wetland?

5. **Economics:**
    a. How influential has economics or finances been in the development of your wetland?

6. **Information:**
    a. When creating your wetland, if you needed information where did you get it from?

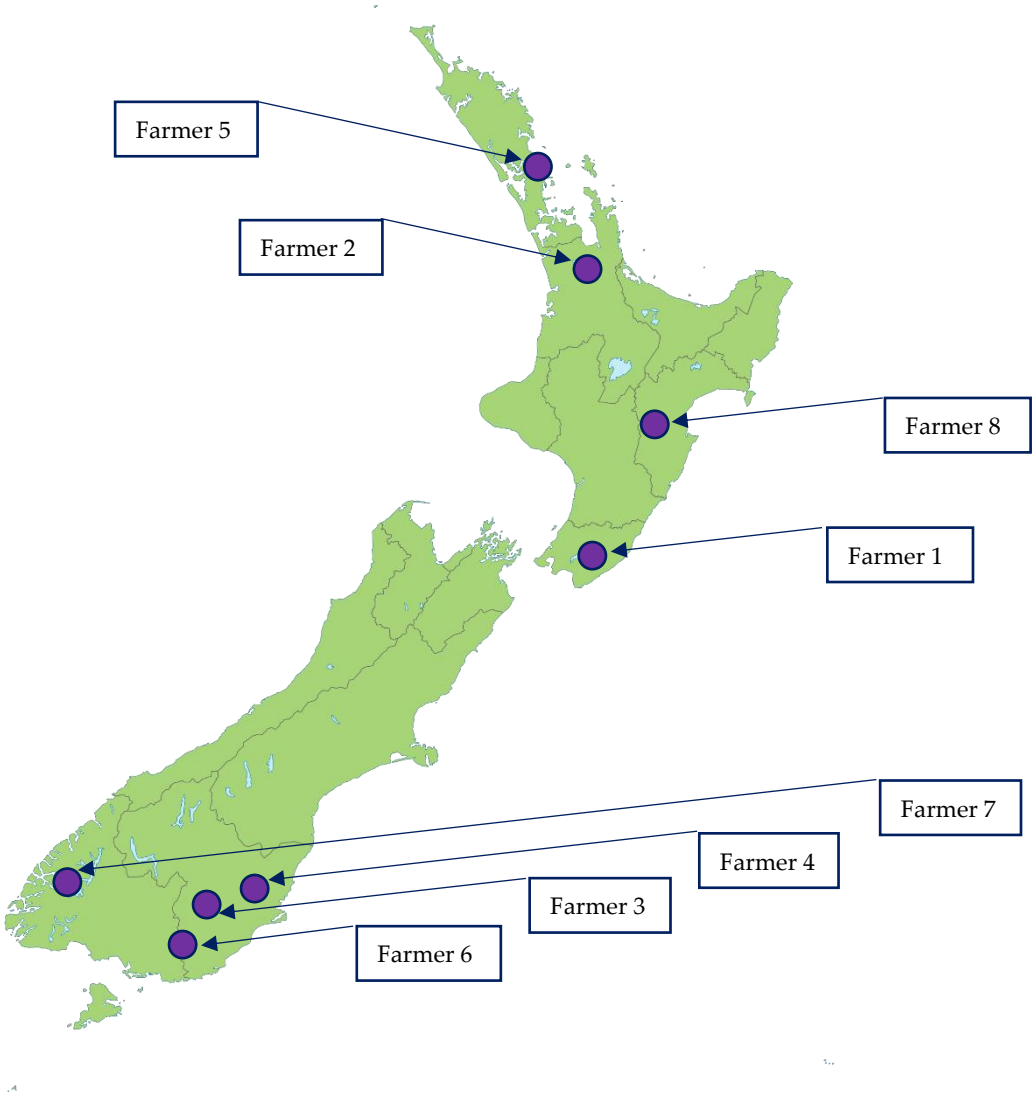
7. **Outcomes of the process:**
    a. Since creating your wetland have you noticed a change in how you think about ecology or the environment?

b. What do you think would have made the process of creating your wetland easier?

8. **Conclusion:**
    a. Is there anything you would like to add or anything that you would like to ask me?
    b. THANK YOU!

Appendix C: Case study background information

Figure depicting the general location of the case study sites



Farmer 1

Farmer 1 operates an intensive dairy farm, located in the South Wairarapa District. For the past twelve years they have jointly owned the farm as part of a syndicate, which owns 275 ha and leases an additional 50 ha of paddocks. Farmer 1 has a strong background in conservation and has been involved in a number of environmental groups, including having worked for the Queen Elizabeth II National Trust. The wetland they created was small (0.75 ha) but also highly artificial, making its design quite complex. Development of their wetland started four years ago and involved extensive planting, fencing, alterations to drainage, and weed removal. Farmer 1 was motivated to create their wetland as part of

their philosophy of being a good citizen. It was important that the project assisted in their continued social licence to operate and had a tangible economic return.

Photograph of Farmer 1's wetland

Farmer 2

Farmer 2 has owned and operated a small 90 ha dairy farm for the past thirty-six years in the Waikato. Their family was very supportive of their wetland project and were heavily involved in its development. Farmer 2 spent an extensive amount of time establishing their wetland, which they started developing eighteen years ago. The wetland they created was 16 ha, making it a large project. Fortunately, many of the native plants were able to self-regenerate, thus, drastically reducing the level of work needed. However, developing the wetland still required high levels of effort and included extensive weed removal, planting, and fencing. The ongoing maintenance of weeds was a major concern for the farmer. Farmer 2 was strongly motivated by environmental reasons and believed in undertaking the work for the benefits it provided not only them but also for other New Zealanders. Farmer 2 was extremely driven to establish their wetland.

Photograph of Farmer 2's wetland

Farmer 3

Farmer 3 owns a sheep, cropping and grazing farm, which is 276 ha and located in South Otago. They are the sixth generation in their family to operate the farm. Farmer 3 spent an extensive amount of time developing their wetland, which they started work on forty years ago. Their wetland is 20 ha, making it the largest wetland in the case study research. Creation of their wetland involved earthworks, fencing, and planting of both native and exotic species. Farmer 3 was originally motivated to establish their wetland to create a duck shooting pond larger than their neighbour. However, as the project progressed they also became interested in improving water quality on their property.

Photograph of Farmer 3's wetland

Farmer 4

Farmer 4 jointly owns their 1430 ha sheep and beef farm with their wife and parents, in North Otago. Farmer 4 was the youngest farmer in the case study research and were still developing their farm, which they purchased eleven years ago. Their wetland, which they began creating five years ago, is 6.7 ha and was designed to include a pond. To establish their wetland it was fenced and a mixture of native and exotic plant species were incorporated. Additionally, many of the native species were able to self-seed. Farmer 4 was motivated to create their wetland for aesthetic reasons, to protect stock, and for recreational activities, such as duck shooting and kayaking with their family.

Photograph of Farmer 4's wetland

Farmer 5

Farmer 5 jointly operates a beef farm in Northland with their family. The family owns 175 ha, and leases an additional 60 ha. Farmer 5 is the fifth generation to operate their family farm. They have an extensive background in environmental management, including both formal qualifications and practical experience. Their wetland is 7 ha and its establishment started six years ago by fencing the area, undertaking earthworks, altering drainage, and planting native species. Farmer 5 was strongly motivated to establish their wetland for environmental reasons and by creating their wetland they aimed to leave the land in a better state than when they received it.

Photograph of Farmer 5's wetland

Farmer 6

Farmer 6 owns a 40 ha beef farm in South Otago, which they have lived on for the past 10 years. They are the head farmer of a water catchment group in their area and have invested a substantial amount of time into driving the projects undertaken by the group. They are yet to establish a wetland on their farm but intend to create one which is small and easy to implement with on-farm equipment. Farmer 6 was motivated to develop a wetland to aid in improving the water quality in their catchment.

Farmer 7

Farmer 7 has owned a 224 ha sheep, beef, and dairy grazing farm in Southland for the past eleven years. They started establishing their wetland four years ago and it now covers 15 to 20 ha. The main work involved in its creation was fencing and earthworks, as many of the native plants were already established. Farmer 7 was motivated to create their wetland for aesthetic reasons and to provide shelter for their stock. In addition, they also use the wetland for duck shooting and therefore a pond was included as part of their wetland design.

Photograph of Farmer 7's wetland

Farmer 8

Farmer 8 owns a sheep, beef and deer farm in the Hastings area, and is the second generation in their family to operate the farm. Their farm is 456 ha, of which 345 ha is used for agricultural production. When Farmer 8 first started work on their wetland seventeen years ago it was a joint project with their father, who owned the farm at the time. Together the wetland areas they have developed on their farm cover 4.4 ha. The wetlands were established by fencing the areas and planting them with a mixture of native and exotic species. Farmer 8 was motivated to develop their wetland to protect their stock, and it worked in well with their planned paddock subdivision.

Photograph of Farmer 8's wetland